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THE SOUTH MAGNETIC POLE*

THE MAGNETIC INCLINATION AND DECLINATION IN THE APPROACHES TO IT, AS DEDUCED FROM OBSERVATIONS MADE IN 1840 BY THE UNITED STATES EXPEDITION COMMANDED BY LIEUT. CHARLES WILKES, U.S.N.

BY

G. W. LITTLEHALES

The Congress of the United States, having in view the extension of the empire of commerce and science, by an Act of the 14th of May, 1836, authorized an expedition to be fitted out for the purpose of exploring and surveying in the Pacific Ocean and the South Seas; and on the 10th of August, 1838, the sloops-of-war *Vincennes* and *Peacock*, the ship *Relief*, the brig *Porpoise*, and the tenders *Sea Gull* and *Flying Fish*, composing the squadron of the Exploring Expedition, set sail from Norfolk under the command of Lieut. Charles Wilkes, U.S.N.

It was the first of the great undertakings in which the national munificence was employed in the cause of exploration at sea, and, although its fundamental purposes were to promote commerce and navigation, to diminish the hazards of the ocean, and to point out to future navigators a course by which they might avoid dangers and find safety, one of the primary aims was also to extend the bounds of science and promote the acquisition of knowledge.

An abundant instrumental equipment was procured from the best English, French and German makers, and a corps of scientists accompanied the expedition for the more successful attainment of its purposes.

The world has long known and benefited by the results of the

* Map facing p. 80.

labors of this Expedition in hydrography and geography, in astronomy and meteorology, in botany and horticulture, in philology, geology and biology. This will appear from the array of resulting scientific volumes for which the country is particularly indebted to the Joint Committees on Library of the Twenty-seventh and Twenty-eighth Congresses, to whose supervision the execution of the provisions for the publication of these works was entrusted.

Senate Report No. 391 of the Thirty-fifth Congress, 2nd session, sets forth that the plan of the work embraced twenty-four volumes and fourteen atlases, and that, on March 3, 1859, there had been published:

The narrative of the Expedition, in five volumes with atlas; Philology (vol. 6), Zoophytes (vol. 7), with atlas; Ornithology and Mammalogy (vol. 8), with atlas; Races of Men (vol. 9), Geology (vol. 10), with atlas; Meteorology (vol. 11), Mollusca (vol 12), with atlas; Crustacea (vols. 13 and 14), with two atlases; Botany (vol. 15), with atlas; Ferns (vol. 16), with atlas, and Herpetology (vol. 20), with atlas; further, there were nearly printed for publication: Botany, by Torrey (vol. 17), with atlas; Botany, by Gray (vol. 18), with atlas, and Hydrography (vol. 23), with two atlases; that the manuscript of the Geographical Distribution of Plants by Pickering (vol. 19) was complete; that the manuscripts of Ichthyology by Agassiz (vols. 21 and 22), with two atlases, were nearly ready, and that the volume on Physics (No. 24) was in progress.

Volumes 17 and 23 treating of Botany and Hydrography were subsequently published, but the printing of volumes 18, 19, 21 and 22 was never completed; and, when in 1876, Congress postponed indefinitely further steps in the publication, as shown by Senate Report No. 60, 44th Congress, 1st session, the contemplated volume on Physics does not appear to have emerged from the manuscript stage.

These unpublished observations, and the results which should have been derived from them, have thus far been lost to the world, and the Expedition worked in vain as far as any benefit has yet been derived from the pendulum, tidal, magnetic, and other physical results that were intended to be discussed and included in the volume on Physics.

The searches of thirty years did not reveal any trace of the manuscript records of these observations until fragments were recently found among the household papers of the descendants of Admiral Wilkes. Although they had been subjected to many

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vicissitudes in their removal from place to place with the family effects, it was possible, through the gracious kindness of the Misses Wilkes, to extract from them the material for a complete representation of the lines of magnetic inclination and declination in the approaches to the South Magnetic Pole and along the borders of the Antarctic Continent, from the facts of observation as recorded by observers equipped with magnetic instruments of the highest order of excellence, on board the four ships of that part of the Expedition which penetrated the Antarctic region.

The results of the discussion of the recovered observations have yielded the accompanying map, which shows, in addition to the lines of the variation of the compass or magnetic declination and the lines of dip or magnetic inclination for the epoch 1840, the edge of the icy barrier bordering the continent as plotted by the Americans. Such magnetic lines from original observations made long ago have a value which increases with the lapse of years on account of their importance in elucidating the changes which time works in altering the magnetic state of the earth.

Value would not attach to the recovery of the tidal observations and the records of the pendulum experiments in the same degree as to the magnetic observations, because, as the tides and the force of gravity in a given locality do not appear to change with the course of time, the loss of the records in relation to them might be made good by taking observations at any subsequent period at the same stations.

But it is not so with the elements of the earth's magnetism. The observations of them yields the record of a fleeting condition to which we can never reascend until the laws of their age-long changes come to be understood.

It will be remembered that, during the year 1839, after having examined many of the island groups with which the vast area of the Pacific Ocean is studded, the Exploring Expedition had reached the Australian shores. On the day after Christmas in 1839, the *Vincennes*, *Peacock*, *Porpoise* and *Flying Fish* headed southward from Sydney, and, falling in with the land in latitude 64° south and longitude 158° east of Greenwich, on the 16th of January following, skirted the border of a new continent to the eastward as far as longitude 97° east of Greenwich. Returning to Sydney, Wilkes announced his discovery in the following words, in a report to the Secretary of the Navy, dated March 11, 1840:

"It affords me much gratification to report that we have discovered a large body of land within the Antarctic Circle, which I

have named the Antarctic Continent, and refer you to the report of our cruise and accompanying charts, enclosed herewith, for full information relative thereto."

During the cruise, in the opening months of 1840, the observations were taken which are now brought forward for discussion:

TAKEN ON BOARD THE SHIP VINCENNES

Date 1840.	Latitude South.	Longitude East.	Declination.	Inclination.	Needle.		Reference.
Jan. 11	63°-32′	164°-55′	23°-04′ E.	81°-24′-32″ S.	Gambey	(.)	V. 1
				81 -11 -15	"	(..)	
Jan. 18	66 -08	154 -53	20 -00 E.	86 -28 -19	"	(.)	V. 2
				86 -21 -00	"	(..)	
				83 -16 -30	"	(.)	
				83 -08 -37	"	(..)	
Jan. 23	66 -47	148 -10	19 -06 E.	87 -42 -45	"	(.)	V. 3
				87 -38 -15	"	(..)	
Jan. 25	67 -04	147 -30	11 -46 E.	87 -16 -15	"	(.)	V. 4
				87 -12 -46	"	(..)	
Feb. 1	66 -15	138 -00	2 -30 W.	85 -30 -15	"	(.)	V. 5
				85 -16 -05	"	(..)	
Feb. 7	64 -30	131 -30	7 -08 W.	84 -07 -30	"	(.)	V. 6
				84 -09 -56	"	(..)	
Feb. 12	65 -10	112 -00	49 -30 W.	82 -20 -37	"	(.)	V. 7
				81 -59 -03	"	(..)	
Feb. 14	66 -00	106 -14	59 -31 W.	82 -41 -15	"	(.)	V. 8
				82 -15 -37	"	(..)	
Feb. 17	64 -00	97 -04	54 -39 W.	79 -09 -45	"	(.)	V. 9
				80 -14 -00	"	(..)	

TAKEN ON BOARD THE BRIG PORPOISE

Jan. 9	58°-30′	163°-30′	21°-00′ E.	77°-42′.45 S.	Lloyd	1	P. 1
				78 -18 .75	"	2	
Jan. 11	64 -20	164 -20	25 -35 E.	82 -25 .00	"	1	P. 2
				82 -43 .75	"	2	
Jan. 12	64 -35	165 -40	27 -20 E.	82 -01 .80	"	1	P. 3
				82 -41 .25	"	2	
Jan. 13	65 -08	163 -51	30 -27 E.	83 -26 .25	"	1	P. 4
				82 -48 .45	"	2	
Jan. 15	66 -08	158 -20	32 -04 E.	83 -56 .25	"	1	P. 5
				83 -30 .00	"	2	
Jan. 17	66 -20	157 -00	26 -17 E.	84 -11 .25	"	1	P. 6
				84 -15 .00	"	2	
Jan. 22	66 -30	151 -40	22 -08 E.	85 -30 .00	"	1	P. 7
				85 -35 .62	"	2	
Jan. 23	66 -50	151 -25	21 -04 E.	85 -43 .12	"	1	P. 8
				85 -41 .25	"	2	
Feb. 1	64 -40	131 -00	9 -33 W.	85 -18 .75	"	1	P. 9
				85 -22 .50	"	2	
Feb. 9	64 -50	111 -00	46 -49 W.	83 -33 .75	"	1	P.10
				83 -18 .75	"	2	
Feb. 11	65 -35	106 -00	53 -16 W.	82 -22 .30	"	1	P.11
				82 -03 .52	"	2	
Feb. 13	64 -40	102 -00	55 -10 W.	81 -00 .00	"	1	P.12
				81 -00 .00	"	2	

TAKEN ON BOARD THE SHIP PEACOCK

Jan. 23	66°-52′	150°-24′-45″	15°-00′ E.	86°-10′	Robinson	H.
				86°-23′	Lloyd	

In consequence of the very near approach to the magnetic pole which the great amount of dip indicates, and the consequent curvature of the lines of equal dip, the observations are to be treated by gathering them together into groups so circumscribed that within the limits of each no important error could arise in considering the isoclinal line to coincide with its tangent. On inspecting the observations with this purpose, it was seen that, by leaving out of view the observations P. 1 and V. 9, the remainder might be arranged in four groups, each comprised within less than ten degrees of longitude, and of which the whole would be included within less than four degrees of latitude. Adopting this method, taking the mean of the readings of the needles of each set, and reducing the minutes to decimals of a degree, the arrangement of the groups is as follows:

Group A.				Group B.			
Reference.	Latitude.	Longitude.	Dip.	Reference.	Latitude.	Longitude.	Dip.
P. 3	64°–35′	165°–40′	82°.359	V. 2	66°–08′	154°–53′	84°.810
V. 1	63 –32	164 –55	81 .298	P. 7	66 –30	151 –40	85 .547
P. 2	64 –20	164 –20	82 .573	P. 8	66 –50	151 –25	85 .705
P. 4	65 –08	163 –51	83 .122	H.	66 –52	150 –24 45″	86 .275
P. 5	66 –08	158 –20	83 .719	V. 3	66 –47	148 –10	87 .675
P. 6	66 –20	157 –00	84 .219	V. 4	67 –04	147 –30	87 .241
Group C.				**Group D.**			
V. 5	66 –15	138 –00	85 .386	V. 7	65 –10	112 –00	82 .164
V. 6	64 –30	131 –30	84 .145	P. 10	64 –50	111 –00	83 .437
P. 9	64 –40	131 –00	85 .344	V. 8	66 –00	106 –14	82 .474
				P. 11	65 –35	106 –00	82 .215
				P. 12	64 –40	102 –00	81 .000

On examining group C, it is obvious by mere inspection that the observations P. 9, made on board the *Porpoise*, does not correspond with the other two, made on board the *Vincennes*. On trial it was found that the combination of these three would indicate a decrease of inclination with an increase of latitude, which is contradicted by all the other observations. As the probabilities appear to be in favor of the accuracy of the observations made on the *Vincennes*, the observation of the *Porpoise* has been rejected in the treatment of this group.

In group A, if we take as a central position a point in latitude 65°–30′ South and longitude 161°–30′ East, we have for the geographical co-ordinates of the places of observation:

Place.	Difference of Latitude.	Difference of Longitude.		
P. 3	— 55′	+4°.10 =	+107.2995	geographical miles.
V. 1	—118	+3 .25 =	+ 91.3638	" "
P. 2	— 70	+2 .50 =	+ 73.6329	" "
P. 4	— 22	+2 .21 =	+ 59.2916	" "
P. 5	+ 38	—3 .10 =	— 67.8758	" "
P. 6	+ 50	—4 .30 =	—108.3821	" "

Let. d = the difference between 81° and the dip or inclination at the central position.

" y = the increase of dip for each minute of latitude in fractions of a degree.

" x = the increase of dip for each geographical mile of longitude in fractions of a degree.

Then the following equations of condition may be formed:

$$\begin{aligned}
-1.359 &= d + 107.2995\,x - 55\,y \\
-0.298 &= d + 91.3698\,x - 118\,y \\
-1.573 &= d + 73.6329\,x - 70\,y \\
-2.122 &= d + 59.2916\,x - 22\,y \\
-2.719 &= d - 67.8578\,x + 38\,y \\
-3.219 &= d - 108.3821\,x + 50\,y
\end{aligned}$$

Forming normal equations from these by the method of least squares, and solving for d, x, and y, we obtain:

d= −2°.353958, and the dip at the central station = 83°.353958
x= −0°.000795
y= −0°.016706

For the angle u, which the isoclinal line makes with the meridian, we have

$$\tan u = \frac{y}{x}$$

Whence u = + 87°−16′−32″.

Making the direction of the isoclinal line from N. 87°−16′−32″ E. to S. 87°−16′−32″ W.

Calculating the dips at the several stations from the above results, we obtain the following differences between the calculated and observed dips:

PLACE.	DIFFERENCE.
P. 3	−0°.161431
V. 1.....	−0°.157234
P. 2.....	+0°.329924
P. 4.....	+0°.088437
P. 5.....	+0°.215825
P. 6.....	+0°.115906

In group B, if we take as a central position a point in latitude 66°−30′ south and longitude 151° east, we have for the co-ordinates of the places of observation:

Place.	Difference of Latitude.	Difference of Longitude in Geographical Miles.
V. 2.....	−22′	+94.2740
P. 7.....	0	+15.9500
P. 8.....	+20	+ 9.8352
H.	+22	−13.8487
V. 3.....	+17	−67.0156
V. 4.....	+34	−81.8236

Treating these in the manner just illustrated in relation to group A, we obtain

d= —2.301293, and the dip at the central position 86°.301293
x= +0.022106
y= +0.021807
u= +43°-38′-55″

For the differences between the observed and calculated dips in this group, we have:

PLACE.	DIFFERENCE.
V. 2.....	+0.128814
P. 7.....	—0.401702
P. 8.....	+0.042864
H.	+0.131482
V. 3.....	+0.250739
V. 4.....	—0.152598

Of group C we retain only the observations designated V. 5 and V. 6. The calculations made from these give the following results for a central position in latitude 63°-30′ south and longitude 135° east.

d= 0.854107, and the dip at the central position=84°.854107
x= 0.000000
y= +0.011815
u= 90°

whence the difference between the observed and calculated values of the dip become

—0.000180
+0.000207

In group D the following results were obtained for a central position in latitude 65° south and longitude 107° east.

d= 1.1071529, and the dip at the central position=82°.1071529
x= —0.0062103
y= +0.0054502
u= —41°-16′-13″

The differences between the observed and calculated values of the dip are:

PLACE.	DIFFERENCE.
V. 7..... ..	—0.7801154
P. 10.....	+0.7505259
V. 8.....	+0.1560298
P. 11.....	+0.0711197
P. 12.....	—0.2058669

If we consider that the probable position of the south magnetic pole could be found by means of the intersection of the normals to the isoclinal lines, the groups B, C, and D would furnish a remarkable result. Upon a polar gnomonic projection the three direc-

tions converge almost to one point. The direction of the normal of group A will not, however, intersect that of B on the southern side of the isoclinal line.

The computed position of the magnetic pole, from a combination of groups B and C, was

Latitude 68°–56′–15″ south, Longitude 135° east;

and, from a combination of groups C and D,

Latitude 68°–42′–07″ south, Longitude 135° east.

The isoclinal lines would appear from inspection of the values of u, in the four separate groups to be curves of contrary flexure, changing the direction of their curvature between the groups A and C, and thence forming an oval, concave toward the south. Calculation further shows that the magnetic polar distances of the central points of the four groups A, B, C, and D are, respectively, 12°–48′–04″, 7°–22′–04″, 12°–38′–30″, and 15°–29′–56″, and the average of these would indicate that the magnetic pole was in latitude 77°–12′ south.

The highest dip observed by Wilkes was 87°–40′, and the compasses on the ice were very sluggish, pointing 19°–06′ east of the meridian as accurately as could be determined; this was in longitude 148°–10′ east and latitude 66°–47′ south.

The indications would point to the fact that the south magnetic pole was not then a mere point, but that there must have been a large irregular area over which the dipping needle stood vertical or very near vertical.

The observations for the variation of the compass or magnetic declination are so numerous that after plotting all of them the isogonic lines could be drawn very readily with the help of the variation lines laid down upon the chart of the Antarctic Continent in volume I of the Atlas of Charts accompanying the volume on Hydrography of the Exploring Expedition; and they are thus included in the accompanying map of Magnetic Declination and Inclination in the Approaches to the South Magnetic Pole.

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THE HEART OF THE ANTARCTIC*

BY

EDWIN SWIFT BALCH

(Map facing p. 80)

In the annals of Polar discovery, no more brilliant exploit can be found than the Antarctic voyage of exploration under the command of Ernest H. Shackleton. Well conceived, well planned and well carried out, it has added to the realm of geography a vast amount of knowledge. The narrative of the journey is clear, accurate and temperate. The make-up of the book, paper, printing and illustrations, is a worthy setting for the narrative; altogether there can be nothing but praise for the efforts of the authors and the publishers.†

Shackleton was a member of Captain Scott's expedition in the *Discovery,* and in the year 1907, outlined a new expedition of his own. He succeeded in securing sufficient funds, principally through loans which he was to pay off on his return. It is pleasant to record that the British Government voted him £20,000 after his successful journey, a sum which enabled him to clear off all his debts. He was also knighted on King Edward's birthday, showing how England rewards its own Polar discoverers.

He purchased an old whaler, the *Nimrod,* which proved to be a fairly good boat. The expedition was carefully fitted out with food, clothing, general stores, and scientific instruments. A wooden hut was built and carried in pieces for re-erection in the Antarctic. A motor car, some dogs and Manchurian ponies were also taken along.

The shore party consisted of fifteen men:

Ernest Henry Shackleton, commander. Born 1874. Went to sea at the age of sixteen, became a lieutenant in the Royal Naval Reserve. In 1901, he joined the British National Antarctic expedition, and was a member of the "farthest south" party. Was defeated for Parliament in 1906.

J. B. Adams, lieutenant Royal Naval Reserve, meteorologist.

Bertram Armytage, in charge of ponies.

Sir Philip Brocklehurst, assistant geologist.

Professor T. W. Edgeworth David, F.R.S., geologist.

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* "The Heart of the Antarctic." Being the story of the British Antarctic Expedition, 1907–1909, by E. H. Shackleton, C.V.O. 2 vols. With an Introduction by Hugh Robert Mill, D.Sc. An Account of the First Journey to the South Magnetic Pole by Professor T. W. Edgeworth David, F.R.S. J. B. Lippincott Company, Philadelphia, 1909. $10.

† The Society is indebted to the J. B. Lippincott Company for permission to use the photographic illustrations reproduced here from Shackleton's book.

Bernard Day, electrician and motor expert.
Ernest Joyce, in charge of stores, dogs, sledges and zoological collections.
Dr. A. F. Mackay, surgeon.
Dr. Eric Marshall, surgeon and cartographer.
Douglas Mawson, mineralogist.
James Murray, biologist.
Raymond Priestley, geologist.
William Roberts, cook.
Frank Wild, in charge of provisions.

The *Nimrod* left Lyttelton, New Zealand, on Jan. 1, 1908. She was towed by the *Koonya* as far as the ice, following in the main the 180th meridian. Some heavy weather was encountered, the waves being estimated as rising to as much as 42 feet in height. Pushing down Ross Sea, the *Nimrod* reached the Great Ice Barrier on Jan. 23, in about 172° West. She followed the Barrier eastward, to nearly 162° West, when steep and rounded cliffs and sharp peaks, rising to a height of approximately 800 feet, were seen behind the ice. This is possibly new land, which was not noticed by Sir James C. Ross or Captain Scott. The ice beyond this point was so thick that further progress was impossible, and thus Shackleton was prevented from wintering on King Edward Land, as he had originally intended. He therefore turned the *Nimrod's* prow west and sailed to McMurdo Sound, which he reached on Jan. 29. During Feb., stores and equipment were landed and the hut was set up at Cape Royds, Ross Island, and on Feb. 22, the *Nimrod* sailed for New Zealand.

The first of the three important land journeys carried out by Shackleton's expedition, the ascent of the volcano Erebus, was undertaken almost immediately. On March 5, 1908, a party of six, Adams, Brocklehurst, David, Mackay, Marshall and Mawson, started from Cape Royds, and carried out successfully this difficult ascent. There was only one mishap, namely that Brocklehurst's feet were badly frost-bitten, necessitating, later, amputation of one of his big toes. The party reached the summit, 13,370 feet, on March 10, and returned to Cape Royds a couple of days later.

The crater was found to be about 900 feet deep and half a mile wide, and every little while great masses of steam would rush upwards with a loud hissing sound. The most unique feature was the ice fumaroles, of which about fifty were seen. These are ice mounds, resulting from the condensation of vapors around the orifices of ordinary volcanic fumaroles, forming ice structures unknown in any other place in the world, and which could only exist under conditons of very low temperatures.

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MOUNT EREBUS AS SEEN FROM WINTER QUARTERS.
Old crater on the left, and active cone rising on the right.

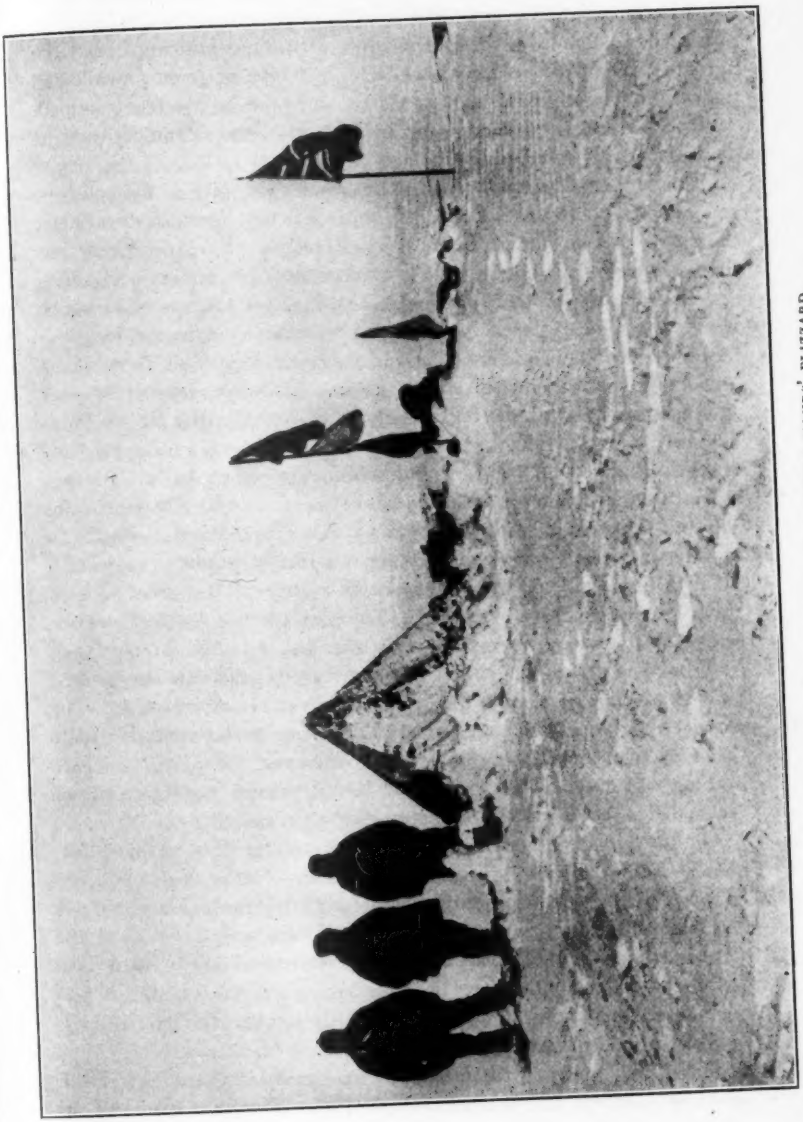
Erebus was steep and icy from bottom to top, the temperature sometimes fell below zero, and there were snow storms and blizzards. Altogether this ascent, by far the highest yet accomplished in Antarctica, must rank among the most difficult of mountain climbs yet made. Erebus is a magnificent mountain. It was watched all through the winter, and every now and then, sometimes at intervals of a quarter of an hour, a strong glow was seen on top. Sometimes great bursts of flame were seen crowning the crater. The column of steam that rises from the crater sometimes rose 3,000 or 4,000 feet before it spread out and was blown horizontally by the upper air currents. The deep red glow occasionally seen on the steam cloud revealed the presence of molten lava in the crater. Altogether there are proofs sufficient to show that Erebus possesses considerable volcanic activity.

The winter was spent in the usual polar manner, taking observations, preparing for sledge journeys, and inventing amusements, such as printing a small book, to pass the time. In September, a preliminary voyage was made to the south, to place depots of stores on the Ice Barrier.

The southern party, consisting of Shackleton, Adams, Marshall and Wild, left the winter quarters on October 29, 1908. They travelled almost due south, at first on the Great Ice Barrier. On this, both going and coming back, they had some trouble with crevasses. On Nov. 26, 1908, they reached 82° 18′ South Lat., just beyond Scott's farthest southern point. New mountain ranges, the continuation of Victoria Land, now began to appear, extending in a south-southeast direction and thereby gradually crossing the direct route to the South Pole. The party kept travelling on the Barrier until Dec. 2, when they were in latitude 83° 28′ S., where the mountains fairly blocked the way directly south.

Here an enormous glacier, stretching almost due south, flanked by huge mountains, and throwing its ice out on the Barrier, fortunately afforded a sort of portal by which the ice cap above could be reached. Up this glacier, afterwards called the Beardmore Glacier, the southern party now forced their way, making one of the most remarkable ascents in the history of mountaineering. Difficulties began at once. Snow slopes changed into blue ice, with numberless crevasses, many of them razor-edged. At 83° 40′ S., a bird, of a brown color, with a white line under each wing, flew past in a southern course. It was not a skua gull. This was the furthest point at which any living thing was seen.

On Dec. 7, they traversed some exceedingly crevassed ice.



THE FURTHEST SOUTH CAMP AFTER SIXTY HOURS' BLIZZARD.

Shackleton, Adams and Marshall were pulling one sledge, and Wild was leading the only remaining pony drawing the other sledge. The first party passed over a hidden crevasse without noticing it, but the greater weight of the pony broke the lid. The pony was swallowed up in the depths of the ice, but fortunately the swingletree snapped, and Wild and the sledge were saved. This was at an altitude of 1,750 feet.

Steady progress was made up the glacier, in spite of the constant danger from crevasses, and the improper foot gear of the party. They were wearing fur boots without spikes. So far nothing has been suggested in the way of suitable boots for mountain climbing in exceedingly low temperatures. The need of some boot in which there are spikes, placed so as not to transmit cold to the feet, has been noticed in the Himalaya and the Antarctic, and there is an opportunity for some inventive genius to devise some new foot covering for use on the highest mountains and in the South Polar regions.

In latitude 85° S., Wild found some seams of coal from 4 inches to 8 feet in thickness, with sandstone intervening. On Christmas day the party were in latitude 85° 55′ S. The glacier proved to be about 130 miles in length, and its top was fairly reached on Dec. 31, at an altitude of 10,477 feet, when the party at last stood on the great ice cap of East Antarctica. The plateau rose gently, however, and on Jan. 3, 1909, they were at an altitude of 11,220 feet.

Food was getting short and rations were steadily cut down. Terrific blizzards swept over the ice cap, the wind sometimes howling along at 80 or 90 miles an hour. The thermometer recorded from 60° to 70° of frost, and on several occasions, the party could do nothing but lie in their bags and let the storm rage past them. Nevertheless these gallant men steadily pushed south.

On Jan. 9, 1909, Shackleton reached his extreme southern point, in latitude 88° 23′ S., longitude 162° E., at an altitude of about 11,600 feet. Here they looked south with powerful glasses, but could see nothing but the dead white snow plain. There was no break in the plateau as it extended toward the Pole, and there can be scarcely a doubt that the South Pole lies in this stupendous plain of ice. Shackleton then hoisted Queen Alexandra's flag, and took possession of the ice in the name of King Edward VII.

The return journey was made almost exactly in the tracks of the outgoing journey, and the food depots were fortunately picked up one by one. It was a long retreat with starvation stalking on their heels. In almost every case they reached each depot with their food

bags empty, and it seems almost a miracle that they ever returned at all. After leaving the plateau, they descended the Beardmore Glacier to the Ice Barrier, which they followed to the winter quarters on March 1, where they found the *Nimrod* awaiting them.

The latitude observations on the southern journey were taken with a theodolite, the last one being made in 87° 27′ south. The important results of the journey are the discovery of the mountain chain stretching beyond Mount Longstaff towards Alexander Land; the fact that the ice cap of East Antarctica almost surely stretches to the South Pole and probably far beyond it; and the discovery of coal and fossil wood, which sheds some light on the past geological history of the continent of Antarctica.

Simultaneously with Shackleton's southern trip, a journey was made to the north by David, Mackay, and Mawson, on which the South Magnetic Pole was reached. They left Cape Royds on Oct. 5, 1908, and travelled north on the sea ice along the coast as far as the Drygalski Glacier, in about 75° 30′ S. L., which they reached on Nov. 30. The party had neither dogs nor ponies, and so had to drag their two sledges and cover each piece of ground, or rather sea ice, three times. Up to this point they had no particular trouble, although they soon discovered that if they were to reach the South Magnetic Pole, they would have to travel on short rations.

During the next four weeks, the northern party was busy crossing the Drygalski Glacier, and ascending one of its feeders, the Larsen Glacier, to the ice cap of East Antarctica. They only gained 20 miles in these efforts, encountering great difficulties from steep ice ridges and crevasses, and twice failing in attempts to climb to the plateau, first by the Mount Nansen Glacier and then by the Bellingshausen Glacier. By the end of December, they were fairly through the coastal range, and began to ascend the ice cap.

The party now made a bee line across the ice cap to the South Magnetic Pole. The ice cap rose slowly, from an altitude of 2,800 feet at the head of the Larsen Glacier, to an altitude of 7,350 feet. Soft snow in places, and many sastrugi gave a good deal of trouble, and some blizzards interfered with the travellers. On the whole, however, they made rapid progress, and on Jan. 16, 1909, they reached the South Magnetic Pole, in 72° 25′ S. L., 155° 16′ E. L. As they were only able to stay there a few hours, sufficient observations could not be taken to say that this position is more than approximately correct. They took possession of the South Magnetic Pole for the British Empire, and it may be noted in this connection that the South Magnetic Pole lies almost due south of Wilkes' Cape Hudson.

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On Jan. 17, they started back to the coast, following their up tracks. In some places, they put crampons over their finnesko and found them of decided use. The food was running short and sometimes there was trouble with crevasses, but on the whole, they returned with ease, and reached the ocean at Drygalski Glacier on Feb. 3. By great good fortune, the *Nimrod,* which was searching along the coast for the Magnetic Pole party, reached the spot the next day and sighted the explorers' tent. A gun was fired, whereupon the explorers rushed down to meet the ship, and in so doing, Mawson disappeared twenty feet deep into a crevasse and was nearly lost. They were then taken aboard, and the *Nimrod* sailed to Cape Royds to pick up the southern party.

The geographical results of this journey are important. Mawson triangulated the coast of Victoria Land from McMurdo Sound to Drygalski Glacier, and many new peaks, glaciers, ice tongues, and two small islands were discovered. The position reached at the South Magnetic Pole, south latitude 72° 25′, east longitude 155° 16′, shows that the ice cap extends due south of Cape Hudson, and the altitude at the Magnetic Pole, 7,260 feet, implies that the northern coast must be several degrees to the north, almost to a certainty where Admiral Wilkes charted it in 1840.

A journey up the Ferrar Glacier was made from the winter quarters, by Armytage, Brocklehurst and Priestley, between Dec. 9, 1908, and Jan. 25, 1909. On their return, they encamped one night on the sea ice in McMurdo Sound. This broke off from the shore, and they drifted out to sea. Killer whales were spouting around them and occasionally bumping the floe beneath the explorers. By good luck, the wind changed and drifted the explorers back to the shore, on which they were able to jump and thus save themselves from a watery grave.

On March 4, 1909, the *Nimrod* sailed for the north, with all the members of the expedition aboard. They sailed past Cape Adare and to Cape North, where Shackleton wanted to try to push to the westward. The ice, which appears always to be very heavy in this locality, prevented his doing so, but about 45 miles of new coast line, running first south, then west, were visible. Thence the *Nimrod* returned to New Zealand, and afterwards to England, searching, on her home voyage, for Emerald Island, the Nimrod Islands, and Dougherty Island, none of which was found.

Several points, connected with the expedition as a whole, are of interest and of some novelty.

One is the question of clothing. Some Antarctic expeditions,

REMARKABLE FUMAROLE IN THE OLD CRATER IN THE FORM OF A COUCHANT LION.

notably those of Bruce, Nordenskjöld, Scott, and Charcot, largely abandoned the use of fur garments in the Antarctic, preferring woolen clothing with canvas overalls. Shackleton developed this method of dress to the utmost, using furs only for sleeping bags, shoes and mits. His party had pilot cloth coats and trousers, but eventually even these were almost wholly given up. The sledging parties usually wore two or more sets of various sorts of Jaeger woolen undergarments, over which was placed a suit of windproof Burberry canvas. These garments were extremely light in weight and this conduced materially to the speed of travel. To some extent, however, it also conduced to frostbite. Nevertheless Shackleton's verdict is "that men engaged in polar exploration should be clothed as lightly as possible, even if there is danger of frostbite when they halt on the march."

The health of the party was remarkably good throughout the entire expedition. They apparently suffered most from cases of frost-bite when sledging, and this might be used as an argument that the light woolen clothes, with an outer canvas covering, are not those best suited for Polar work. On the southern journey, the party suffered to some extent from dysentery, and this was attributed to eating the meat from one of the ponies, which was shot one night when in a greatly exhausted condition. It seems probable that his flesh was made poisonous by the toxin of exhaustion, which is said to be the case sometimes with animals that have been hunted. The disease called "colds," as is well known, practically owing to the absence of germs, is never experienced in the Polar regions. Shackleton's party, however, had a few colds, and it was thought they were due to germs contained in a bale of blankets.

It is a fact well known to Polar travellers that the main subject of conversation when sledging is food. Shackleton's and David's parties were no exception to this axiom. Both their diaries give abundant proof of it. Shackleton writes: "Feb. 9: All thinking and talking of food." "Feb. 10: All thinking and talking of food." "Feb. 11: All our thoughts are of food," etc., etc. No one, however, has yet described any of these conversations as well as Shackleton has in one passage which deserves to be quoted at length:

"Now we are on board ship," one man would say. "We wake up in a bunk, and the first thing we do is to stretch out our hands to the side of the bunk and get some chocolate, some Garibaldi biscuits and some apples. We eat those in the bunk and then we get up for breakfast. Breakfast will be at 8 o'clock, and we will have porridge, fish, bacon and eggs, cold ham, plum pudding, sweets, fresh roll and butter, marmalade and coffee. At 11 o'clock we will have hot cocoa, open jam tarts, fried cod's roe and slices of heavy plum cake. That will be all

until lunch at 1 o'clock. For lunch we will have Wild roll, shepheard's pie, fresh soda-bread, hot milk, treacle pudding, nuts, raisins and cake. After that we will turn in for a sleep, and we will be called at 3.45, when we will reach out again from the bunks and have doughnuts and sweets. We will get up then and have big cups of hot tea and fresh cake and chocolate creams. Dinner will be at 6, and we will have thick soup, roast beef and Yorkshire pudding, cauliflower, peas, asparagus, plum pudding, fruit, apple-pie with thick cream, scones and butter, port wine, nuts, and almonds and raisins. Then at midnight we will have a really big meal, just before we go to bed. There will be melon, grilled trout and butter-sauce, roast chicken with plenty of livers, a proper salad with eggs and very thick dressing, green peas and new potatoes, a saddle of mutton, fried suet pudding, peaches à la Melba, egg curry, plum pudding and sauce, Welsh rarebit, Queen's pudding, angels on horseback, cream cheese and celery, fruits, nuts, port wine, milk and cocoa. Then we will go to bed and sleep till breakfast time. We will have chocolate and biscuits under our pillows, and if we want anything to eat during the night we will just have to get it."

Probably no one has ever described so well as yet the talk of men on the verge of absolute starvation.

The Manchurian ponies which Shackleton took along proved most valuable as transport animals, probably better than dogs. They would have been even more so, had it not been for their habits of feeding, which resulted in the death of half of them, before they had been of any use. They were fond of eating bits of rope, the tails of the other ponies, in fact anything they could chew or swallow. When first landed, they ate quantities of the volcanic sand of the sea shore, perhaps because it had a saline taste due to the fact that the blizzards sprayed all the land near the shore with sea water. Three of them died from this cause, which could not be explained until a post mortem examination of one of the ponies revealed the fact that his stomach contained many pounds of sand.

Shackleton makes a brief but valuable statement in regard to a matter of much importance in the history of Antarctic discovery. A party one day started off across the ice to visit Inaccessible Island. It proved a much longer jaunt than was expected and Shackleton says that before they returned "they had learned the first lesson of the Antarctic, which is, that distances are very deceptive, and that land is always much more distant than it appears to be."

The scientific and geographic results of the expedition were numerous and valuable.

An important discovery in biology was that made by Murray, on March 13, 1908, that there were living microscopical animals in the fresh water lakes of Antarctica. He obtained gradually a number of these, principally of the varieties known as rotifers and water

bears. They were generally found adhering to small weeds and plants on which they fed. Experiments were tried, which proved that freezing them at the lowest attainable temperatures, did not in the least affect their vitality. Only by subjecting them to tests in liquid air, would it be possible to ascertain what temperature would kill them: in the lowest Antarctic temperature they can live, possibly for many years.

The observations of Professor David and Mr. Priestley have thrown some new light on the geology and glaciology of Antarctica. Their chief conclusions may be summarized as follows:

1. The majority of the tabular bergs of Antarctica are largely, in some cases wholly, snowbergs. True icebergs are also found. The glaciers push out in some cases thirty miles from the coast, and must be afloat for the greater part of this length. Throughout Victoria Land, there is evidence of a recent great diminution in the glaciation. McMurdo Sound was formerly filled by a branch of the Great Ice Barrier, whose surface rose fully 1,000 feet above sea level, and whose entire thickness was about 4,000 feet.

2. Ross Sea is probably a great subsidence area. The Beacon sandstone formation which extends for at least 1,100 miles along Victoria Land contains coniferous wood associated with coal seams and is probably of paleozoic age. Radiolaria, in a fair state of preservation, occur in black cherts among the erratics at Cape Royds, and obscure casts of radiolaria are found in limestones at 85° 15′ S. Lat. These radiolaria appear to be of older paleozoic age. Peat deposits, formed of fungus, are now forming on the bottoms of some of the lakes in 77° and 78° S. Lat. Raised beaches of recent origin extend at Ross Island to a height of at least 160 feet above sea level.

The Great Ice Barrier remains the greatest mystery of the Antarctic, as well as the most interesting problem in the whole field of glaciology. It may be a bay surrounded by mountains, or it may be a strait extending from Ross Sea to Weddell Sea, or from Ross Sea to between Alexander Land and King Edward Land. Some increase of knowledge as to its formation has, at least, been gained. It moves at the rate of about 500 yards annually towards Ross Sea; it calves away in places, as is proved by the disappearance of Scott's Balloon Bight; and these large masses which break off form great tabular bergs. It is fed to some extent from the great glaciers which pour down into it from the mountains, but it seems mainly formed from the accumulation of the snowfall. Messrs. David and Priestley think it consists of true glacier ice at its sides and inland extremity, but that the center and seaward portion is formed, in its

upper part, chiefly of snow. They agree with Captain Scott's conclusions that, except at its edges and perhaps some distance inland, it must be afloat.

Another most interesting Antarctic problem still remaining unsolved is that of the continuation of the mountain range of West Antarctica. This extends from the Shetlands to Alexander Land and is certainly a continuation of the Andes. It may be that this West Antarctica range runs to King Edward Land, or it may be that it runs to Victoria Land. At any rate, the furthest southern mountain ranges seen by Shackleton point in the direction of Alexander Land. The observations of Messrs. David and Priestley led them to think that the coast line of Victoria Land is of an Atlantic rather than of a Pacific type and they conclude "Possibly as Wilckens has suggested, west of Alexander I. Land, the cordillera is submerged through faulting." Dr. Charcot is at present engaged in trying to get further south than Alexander Land, so let us hope he may bring back some further data about this noteworthy problem in physical geography.

A third most important geographical problem in the Antarctic is the coast line of Antarctica. While Shackleton made no special effort to explore any of this, still he accomplished a good deal. He sighted about 45 miles of new coast line, running first a little south, then due west, of Cape North. As this coast has not received a name, I suggest it be christened "Shackleton Land." While Shackleton's southern journey in no wise solves any coastal problem, nevertheless it enlarges so much the known size of the ice-capped plateau of East Antarctica that it much increases the certainty that this plateau must extend, not only to Wilkes Land, but probably also towards Enderby Land and Coats Land, both of which may turn out to be part of the edge of the great ice plateau of East Antarctica.

Shackleton's expedition is certainly one of the most memorable on record. To all intents and purposes, he has solved the problem of the South Pole itself. The next expedition to Ross Sea may get there, but by so doing, will probably add little to knowledge. The greater problems before such an expedition will be to trace the continuation of the Victoria Land mountains and the southern boundaries of the Great Ice Barrier. It will, however, be no small task for anyone to surpass the efforts of Sir Ernest Shackleton, who is evidently not only a great explorer, but a born leader of men.

XUM

TRADE ROUTES IN THE ECONOMIC GEOGRAPHY OF BOLIVIA

BY

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The economic condition of Bolivia has been so profoundly affected by two railway lines from the seacoast to the principal plateau towns, La Paz and Oruro, and the country is being so rapidly developed by other railway lines now building, that the Bolivia of but twenty years ago is almost completely transformed (Fig. 1). In this respect it

FIG. 1.

compares with Mexico, whose industrial birth likewise dates from the completion of its first railway line to the United States, the line to the American frontier completed in 1884. In both countries the only general means of transportation until a comparatively recent

date were native carrier, pack train, and mule cart. In both cases a lofty tableland is the home of the white population and must be twice overcome in a single communication with the coast. Probably less than 7 per cent. of Mexico's population live on the lowlands of that country today.* In Bolivia less than 12 per cent. dwell upon the eastern tropical and sub-tropical plains.† These figures can only be compared by first noting that more than two-thirds of Mexico is upland while nearly two-thirds of Bolivia is plain (Fig. 2). This

FIG. 2.
From *Bull.* Geog. Soc. of Phil., Vol. 7, No. 2, 1909.

reverses the density ratios and gives Bolivia a much thinner plains population than Mexico. Both countries were long obliged to develop their chief resource, their minerals, under the most stupendous disadvantages that the modern industrial world exhibits.

If Mexico's former difficulties are appreciated, by virtue of our better acquaintance with a nearer neighbor, Bolivia's former difficulties may be best understood by noting that the tableland of Bolivia

* Costa Rica. G. E. Church. *Geog. Journ.*, Vol. 10, 1897, p. 76.

† Approximation, based on data from Geografia de la República de Bolivia, tables in handbooks of S. A., and other sources.

is from one and a half to two and a half times farther from the coast than is the tableland of Mexico and half again as high; and whereas the railway from Vera Cruz to Mexico City climbs to 7,200 feet, in crossing the edge of the tableland, the two lines from Mollendo and Antofagasta ascend to 14,666 feet and 13,700 feet, respectively, in order to reach Bolivia. Furthermore, once the coast of Mexico is gained, a comparatively short ocean voyage at cheap rates places her products in the markets of the largest industrial centers of the world; on the other hand the distance from Bolivia's western outlet ports on the Pacific to New York, by way of the Straits of Magellan, is several thousand miles farther than the direct distance from those ports to the North Pole.

What the isolation and loftiness of the Bolivian situation formerly meant may be illustrated by a few specific examples which will at the same time prepare the way for a discussion of existing transportation conditions and methods in those parts of the country that are not served by railways. In 1884, for instance, all the ores and metals of the Serrania de Guadalupe district in southern Bolivia were transported by mules and donkeys through Argentina to the port of Rosario,* approximately 1375 miles. One mine had been abandoned after the investment of £30,000. Pasley asserts† that he saw the bills of lading at the establishment, from which it appeared that £7,000 had been spent on freight alone from the port of Rosario. Nearly up to the time of the completion of the railway to Oruro from Antofagasta in 1892 the silver and tin of Potosi were transported to the Pacific seaboard, 500-575 miles away, by pack-train and mule cart at incredible cost, the returning caravans bringing back merchandise over the same steep and difficult way. In 1882, Minchin wrote‡ that the rate from Oruro to Tacna, the interior terminus of the railroad from the port of Arica (250 miles) was £15 per ton. Yet at that time the silver output of the country, in spite of these enormous disadvantages, was $8,000,000 to $10,000,000 annually. Ores containing 1 to 1½ per cent. of silver were more advantageously exported to Europe, in spite of high freight rates to the coast, for the value of the accessory minerals, copper, tin, etc., was often in itself sufficient to cover the total cost of transportation. There are more than 10,000 abandoned silver "mines" in Bolivia today.§ They were for the most part abandoned because of lack of capital or labor,

* Descriptive Notes on the Southern Plateau of Bolivia and the Sources of River Pelaya. C. M. S. Pasley. *Geog. Journ.*, Vol. 3, 1894, pp. 105–115.

† *Ibid*, p. 109.

‡ The Tableland of Bolivia. *Proc.* of the Royal Geog. Soc., London, Vol. 4, 1883, pp. 671–676.

§ *Bull.* Int. Bureau of Am. Repub., July, 1908, p. 72.

or both, or on account of ruinous transportation rates, or the flooding of the mines by water on account of the primitive mining methods employed. Among these factors, lack of good transportation facilities stands preëminent. The tax is not only upon the hauling of the mine products to the railway but also upon the enormous cost of machinery and materials of all sorts, especially fuel.

Mining development has often meant an increase in the cost of merchandise imported for general use. In 1861 the freight rates from Cobija, in what is now northern Chile (then Bolivia), to Calama in the Loa valley, 120 miles toward the northeast, were $8 per carga of 300 lbs. When the mines at Caracoles, 90 miles east of Cobija, were opened, they competed so successfully with the merchants for carts and mules for ore transportation that the cost per carga of 300 lbs. rose at once to $15. In 1871 the freight rates from Potosi to Calama (450 miles) were $30 per mule load of 300 lbs. The cost was due partly to the direct labor of transport and partly to the exceptional lack of pasturage and water, forage being a considerable part of the original cargo. The cost of moving a piano (400 lbs.) from Cobija to Potosi (575 miles) was then $320 to $350. To Sucre the price was $60 to $80 more. The freight on a single mule load of bottled beer was $36 to $42 from either Tacna or Cobija to Potosi. The price of goods conveyed by caravan was often increased 100 per cent. in the transit across Atacama and the western Andes to the central plateau. In other words, the average cost of taking a ton of goods from Europe to the central cities of Bolivia by these transportation methods was equivalent to the transportation of the same ton a distance of 20,000 miles by railway at average rates or six times the circumference of the earth by steamship.* These examples will serve to explain why nearly every student of Bolivia's transportation methods finds conditions there today and in the recent past so interestingly similar to that period in our own industrial development west of the Mississippi, in the '50's and later, when bullock cart and prairie schooner were being replaced by railroads.

The early cart roads and mule paths to the coast are of added interest because they are the routes of the railways either now completed or building. The number of these routes to the frontier and the coast was and is very definite, for there are few natural ways out of the country and these have all been used for centuries past. They will be taken up in turn for detailed discussion. The routes are briefly named and characterized as follows (Fig. 3):

* The Route to Bolivia *via* the River Amazon, pp. 143, 148, 149, *et al.* G. E. Church, London, 1877.

FIG. 3.

MOLLENDO-LA PAZ. From La Paz, capital and largest city of Bolivia, over 500 miles west, to and across Lake Titicaca, and over a high tableland, lofty mountains, and the coast desert, to the port of Mollendo in southern Peru.

ARICA-LA PAZ. From La Paz, through similar country, to Arica in Chile. This route would eliminate the double handling now necessary in crossing Lake Titicaca. Furthermore, the distance is shorter and the grades far more favorable. The port of Arica far surpasses Mollendo, both in size and security. It would bring La Paz within twelve hours of the coast.

IQUIQUE-ORURO. From Oruro, on the alto planicie (high plateau) of Bolivia, 150 miles south of La Paz, west to Iquique on the Chilean littoral. Reasonable grades but an unproductive country. Route could not compete with Arica or Antofagasta.

ANTOFAGASTA-ORURO. Oruro is now connected with Antofagasta by a meter gauge railway completed in 1892. It has been the sole railway outlet for southern Bolivia, as the La Paz-Mollendo line has been for northern Bolivia, until the recent opening of the line from

La Paz to Oruro. This short connecting link now allows a choice of routes for plateau commodities.

ARGENTINA-BOLIVIA. The road from Tupiza to Uyuni is now being completed. It follows stream valleys from the northern pampas in Argentina to Jujuy and through the southern border of the tableland of Bolivia to Tupiza and thence to Uyuni on the Antofagasta-Oruro line with which it will connect for northern Bolivia.

PLATEAU-PLAINS. Three related projects eastward from La Paz, Cochazamba and Sorata, have as their common object the opening of the eastern tropical plains of Bolivia to the plateau and the better connection of both plateau and plains with the Amazon and the Atlantic. The conquest of the eastern Andes and of the falls of the Madeira are important parts of this comprehensive scheme. It is unlikely that more than one line will ever be constructed.*

PARAGUAY-SANTA CRUZ. Surveys are now being prosecuted west of Corumbá on the Paraguay for a railway that shall connect Santa Cruz de la Sierra with the Paraguay. It is within the scope of Bolivia's present railway scheme to extend the plateau lines eastward to Santa Cruz which, if accomplished, would give Bolivia uninterrupted passage from the Pacific to the Atlantic.

MOLLENDO-LA PAZ.

The well-known Mollendo-La Paz line may be described briefly. It was begun in 1870 and completed to Lake Titicaca in 1874 and later to La Paz the capital. Formerly this was one of the caravan routes to northern Bolivia, and competed for supremacy with the route from Arica. The latter way, being shorter, was the more important, however, until the completion of the railway line, when it immediately dropped to small importance except as a mail route to Tacna and Arica. The La Paz mails are delivered to Tacna by swift coaches in five days and as even the railway journey from La Paz to Mollendo requires three days and European steamers are often as much as a week apart on the west coast it can readily be seen why this route frequently means an earlier mail to Europe than that to Mollendo and is therefore maintained.

It was an early aspiration of the best Peruvian statesmen to see

* The location of the principal custom houses of Bolivia will indicate the principal routes and the relation of the railways to the main lines of trade. They are as follows: Guaqui (Lake Titacaca), Oruro (the only large plateau city on the Antafagasta-Oruro line), Uyuni (at the point where the caravan trail from Argentina strikes the railway), Tupiza and Tarija (on the way from Argentina to Southern Bolivia), Puerto Suarez, Villa Bella, Abuna, Madre de Dios, and Bahia, on the eastern rivers of Bolivia for the collection of heavy export duties on rubber, chocolate, etc., and the lighter import duties on merchandise.

all the wealth which was originally carried by llamas and donkeys to the coast from Bolivia borne across Lake Titicaca by steamers and across the cold Maritime Cordillera by railroads. The interesting features of the early attempts in this direction were noted by Markham in 1874.* In the '40's an attempt was made by Costas to place a small steamer on the lake. He foresaw the important trade this would both create and serve. The products of the Peruvian and Bolivian forests and eastern valleys—timber, cinchona bark, chocolate,

FIG. 4.
From *Bull.* Geog. Soc. of Phil., Vol. 7, No. 2, 1909.

coffee, coca, fruit, rubber, etc.,—would be conveyed to the coast; the European manufactured goods and the sugar of the Peruvian coast valleys would be imported into Bolivia; a brisk trade in wool, silver, copper, and tin, would follow, and a local traffic in provisions. In 1861 the Peruvian government ordered two screw steamers in London, called the "Yaravi" and "Yapura." They were 20 ton boats of 40 H. P. and were sent out in pieces to the port of Arica, thence to Tacna by rail and finally across the Andes on the backs of mules to Puno,

* Railways in Bolivia. *The Geog. Mag.*, Vol. 1, Apr., 1874, pp. 36–41.

the port at the western end of Lake Titicaca. Several pieces were lost and the project was in abeyance until 1868 when Captain Melgar of the Peruvian navy was appointed to complete the work. He brought up workmen and materials from the coast to the port of Puno and there, in the total absence of all local resources, built a factory and a mole and launched one steamer in June, 1871, the other in March, 1872.

The railroad from Arequipa to Lake Titicaca was constructed by the Napoleon of Peruvian railroad engineering, Colonel Meiggs. He contracted for the line at £6,400,000 or £29,500 per mile. The cost of transport, and of the labor, materials, and provisions was of course enormous. Embankments from 50 to 500 feet high are numerous. In one place there is an 84-foot cut on a hillside with the roadway 1,000 feet of almost perpendicular height above the valley. The distances to water are often long, and from Arequipa to the baths of Yura, seventeen miles, the water was conveyed by mule-back. At Caniaguas it was carried twenty-six miles. The cold of winter at high altitudes is intense. The work was begun in June, 1870; from 4,000 to 5,000 laborers, mostly Chilians and Bolivians, were constantly employed for 3½ years; and on Jan. 1, 1874, the first locomotive reached the shores of Lake Titicaca, 12,500 feet above the sea. The highest point on the old road from Arequipa to Puno is 15,590 feet, that of the present railroad 14,666 feet (Crucero alto).

The building of the northern railway line meant the commercial rehabilitation of the entire region. For not only did it become possible to develop enterprises on the immediate line of the railway but many rich mining claims some distance from the railway, formerly impossible of development because of high freight rates, were found to be commercial possibilities even with mule transportation to the railroad. This principle of dependence of industrial enterprises upon proper means of transportation is abundantly illustrated by every railroad venture in the Republic. Even today there is vast mining development in the country away from the railways, which is possible because of the saving in long hauls to the coast that the part-rail shipments effect. Thus the rich tin mines at Huynuni, 30 miles from the railroad at Machacamarca, ship their concentrates by mule cart down the Huynuni valley and haul in their machinery, much of it extremely heavy, by the same route. Similar illustrations are abundant. Such mining development should not however be thought ideal. The expenses for the additional men, animals, and forage; the breakdowns, the limitations set upon the size and weight of machinery, the delays from swollen streams, and the trans-shipments,

these are but a few of the difficulties which the practical engineer of the region must meet.

One of the best illustrations of the expense incident in some localities on transshipment alone, are the copper mines at Coro-Coro. The partially treated ore from these properties is hauled in mule carts about 20 miles to the Desaguadero River where it is shipped in barges to Guaqui, the port at the eastern end of Lake Titicaca. It is then taken by lake steamers 140 miles to Puno; by freight train to Mollendo, the Pacific port; by barge from the wharf to the steamer

FIG. 5.

From *Bull.* Geog. Soc. of Phil., Vol. 7, No. 2, 1909.

conveying it to its final destination in southern Chile or Europe or the United States: counting the mining operation, the ore is handled *eight* times before delivery to the smelter. The locomotives, steel rails, ties, in fact all the material for the railroads now building in Bolivia must be unloaded into barges from the ocean steamers, after the voyage from the United States, then to the freight trains on the wharf, by rail to Puno, by steamer to Guaqui, and again by rail to the construction camps at the end of the line. What this means in

the case of heavy machinery and steel rails so awkward to handle can better be imagined than described. Every pound of coal must come by the same route at similar expense. Every tie (from Oregon and California) in the Viachi*—Oruro line costs $2 gold.

The Mollendo-La Paz line is of additional service because it made possible the branch to Oruro which is now completed and connects the two largest cities of Bolivia. Construction work has also been carried some distance toward Cochabamba and Potosi. The junction of the capital with Oruro brings about a political solidarity, itself as important for Bolivia's economic development as the railroads are important in their industrial effects. Four large cities, centers of as many great population groups, have developed in distinctly separate parts of Bolivia *viz.*, La Paz, Oruro, Cochabamba, and Sucre (Figs. 4 and 5). Revolutions have in the past gained dangerous headway in consequence and have been difficult to stamp out because of the distances to be overcome through the barren tracts that separate the various population groups. Quick transportation between Oruro and La Paz now gives these cities and the high plateau groups of people a balance of power over Sucre or Cochabamba acting individually. The extension of the railway to Cochabamba would effect still further consolidation politically; and, by offering cheaper communication, would lead to better acquaintance and greater friendliness than has heretofore been possible (Figs. 6 and 7).

Arica-La Paz.

Few railway projects in South America have been considered more frequently and seriously than that from Arica to La Paz, and none seems to be subject to more discouragements. The surveys from Tacna, the present interior terminus of the railway, have been made and actual construction has been begun repeatedly only to be delayed by the financial difficulties of the several companies. The latest contract has been awarded by the Chilean government to a German bank for £3,000,000.† The bank's interest in the matter ceases with the taking of the Government 5 per cent. bonds that are to be issued for the construction of the road. The line will be about 335 miles long and will be completed in four years according to the terms of the contract. The work is to be done in five sections. The government is to provide the right of way and,

*The station on the Molendo-La Paz line, 40 miles east of Guaqui, on Lake Titicaca, from which the Bolivia railway runs south to Cruro.

†Daily Consular and Trade *Report*, Jan. 30, 1908, No. 3087.

as is customary in railway construction in this section of South America, is to admit duty free all material and machinery used in the construction of the road. It is built in accordance with the terms of a treaty made between Chile and Bolivia, March 21, 1905, whereby Chile finally took over that portion of Bolivia which formerly bordered the Pacific.* The rich mineral resources of the section which

FIG. 6. THE PORT OF PUNO.

At the western end of Lake Titicaca. It is the eastern terminus of the railway from the coast at Mollendo, Peru. Steamers connect Puno with the port of Guaqui at the east end of the lake, where there is direct rail communication with La Paz.

the line will serve will mean much for both Chile and Bolivia and besides this there will be introduced a competitor to the Southern Railway of Peru now enjoying a monopoly of the trade of northern Bolivia.

Iquique-Oruro.

The third route is one which has never been seriously considered as an actual rail route by the railway promotors of South America. The suggestion of the route is owing to Minchin† who called attention to the easy and regular grade of the western slope of the

* See any map of Bolivia prior to the war of 1880, or the treaty of 1883.

† The Tableland of Bolivia. *Proc.* of the Royal Geog. Soc., London, Vol. 4, 1882, pp. 671–676.

Andes east of Pica, an oasis 14 miles from the nitrate railway to Central Lagunas, in the province of Tarapacá, northern Chile. Our own observations show that the direct grades are here from 3° to 7° to an altitude of 14,500 feet and the topography and drainage along the route are favorable for the easy construction, by moderate curves, of grades below the lesser value. This railway would have to reach an altitude of nearly 16,000 feet if it crossed the Sillilica range and entered Bolivia via Cueva Negra and Cancosa, but only 14,000 feet if it entered the interior basin south of the volcano Sacaya by way of the borax lake, La Queca, and the town of

FIG. 7. THE PORT OF GUAQUI, LAKE TITICACA.

A dredged channel is maintained between the docks and the open lake, for the lake border is here fringed with extensive marshes.

Canquilla. The road could be constructed for much less than it cost to build either the Antofagasta or the Mollendo line. There are no towns of consequence along the route, merely isolated mountain villages of shepherds who supplement the resources of their flocks by cultivating such alluvial fans as can be irrigated. The chief advantage of such a line would lie in the development of the rich mineral deposits known to occur throughout much of this section of the Maritime Andes, a development that waits absolutely upon the cheap transportation which only the railroad can bring. The existing

trade over this route is in millet, firewood, wool, and skins brought down by the mountain Indians in llama caravans to the oases on the eastern edge of the desert of Tarapacá-Pica, Matilla, Macaya, etc., and there exchanged for cloth, alcohol, fruits, candles, and a host of lesser articles. The trade, while regular, is not considered important enough to warrant the maintenance of a custom house, and smuggling is not only the rule but is winked at by both Chile and Bolivia.

Antofagasta-Oruro.

Before the construction of the railway (completed to Oruro in 1892), over this ancient route, caravans from all that part of the altiplano,* of Bolivia between Potosi and Tupiza converged at Calama, a well-watered oasis in the Loa valley and now a station on the railway a day out of Antofagasta. From Calama two routes led out to the coast, one toward Tocopilla, now an active nitrate port, the other toward Antofagasta and Mexillones. The railway has taken advantage of the same depression in this part of the Andes that guided the routes of the earliest caravans to Calama, a town of several thousand inhabitants. Thence it ascends to a 13,700 ft. pass north of the twin peaks, San Pedro and San Pablo, to enter the great central basin *via* the borax lake, Ascotan. The Lake has an area of 60 or 70 square miles and lies between the volcanic peak of Ascotan and Ollague. The "lake" is really a bed of borate of soda with numerous scattered pools of salt water. The salt crust is from 2 to 7 feet thick and so firm that the old cart road to the coast passes over it. A borax establishment has been manufacturing the deposit on a large scale since the introduction of the railway.

Among the industrial readjustments which the railroad has effected none is more interesting than the retrogressive effect which for a short time the railroad had upon the oasis of Calama (Fig. 8). When it lay on the route of the caravans between seacoast and interior its fertile fields and luxuriant pastures were a source of great wealth to those owners who supplied forage to the pack mules. As soon as this caravan trade was largely supplanted by the more efficient railway service, Calama became only a way station on the railway and was obliged to become self-dependent. While, by virtue of its position, it still attracts the caravan trade of a small district toward the southeast, it is to a much larger extent deprived of the advantages of its former trade relations. For a short time this loss of strategic position was keenly felt, but the recent rapid development of the

*The name given to the high plateau of Bolivia. Often called altiplanicie, central basin, central plateau, etc.

nitrate establishments on the nitrate pampa of Antofagasta has once more stimulated the production of forage for the thousands of mules employed on the caliche carts of the nitrate works, and Calama is now without exception the chief hay producing centre in the whole northern half of Chile. It is correspondingly prosperous, as may be

FIG. 8. SAIL CAR.

On the Antofagasta-Bolivia railway near Calama, Chile. The workmen take advantage of the almost constant winds to run into port at nightfall, literally "blowing into town."

appreciated when one considers the utter barrenness of the nitrate region of Antofagasta and the necessity of importing from southern Chile and Calama the entire forage.

Until the completion of the line between Oruro and La Paz (1908-1909), trains ran daily as far as Calama, but only three times a week from there to Oruro. The gauge is but one meter and the rolling stock of rather a primitive sort, though Pullmans have lately been introduced and the time between Oruro and the coast shortened. The port of Antofagasta is habitually congested and the mine owners of the interior complain constantly of the lack of ore cars for coastal shipments (Fig. 9). This deficiency, whether due to the defective administration of the road or to the actually great amount of traffic,

would be remedied by the competition which the Uyuni-Tupiza line, when completed, would afford. The present condition of the traffic may be judged from the fact that a copper smelter at Calama is able to supply itself with machinery only after the lapse of at least a year. Six months have to be allowed for the delivery at Antofagasta of consignments of machinery from Liverpool and six months for the day's journey to Calama. It may confidently be stated that, unless the gauge is widened and the rolling stock and service improved, the mining development of the region served by the line will soon be unable to increase, notwithstanding the invaluable service which the railway has in the past rendered both the nitrate industry

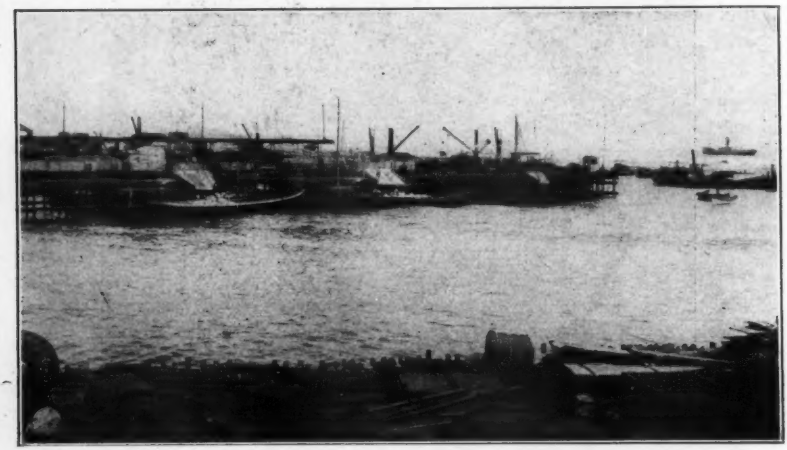

FIG. 9. THE PORT WORKS AT ANTOFAGASTA.

Steamers anchor off-shore (right background) and the cargo is discharged by means of lighters shown tied to the docks. The sacks on the wharf are filled with nitrate.

of the coast and the mines of the interior. The alternative would be the completion of rival railways on the plateau. But such competition can no longer be expected, as certainly was expected when the Bolivia Railway Co. was first organized.

The original plan of operation of the Bolivia Railway Co. frankly included competition with the Antofagasta and Bolivia Railway Co. (Limited). To the north it would connect (at Viachi) with the Mollendo-La Paz line and, to the south, via Potosi and Tupiza, with the Argentine system at La Quiaca. This whole arrangement has, however, been upset by the fact that on Dec. 1, 1908, President Montes of Bolivia signed a bill, recently passed by the Bolivian

Congress, embodying changes in the original concession of the Bolivia Railway Co. The changes were made at the request of the American syndicate building the road. It is a step toward the consolidation of the interests of these two roads and will undoubtedly result in the unification of the railway systems of Bolivia. By the terms of the agreement now embodied in the law, the British company (The Antofagasta and Bolivia Railway Co.) guarantees the interest on the new line of the American company (The Bolivia Railway Co.) just completed between Viachi and Oruro, and makes a payment to the American syndicate for a majority of the new line's stock. The original terms of the American syndicate's concession were still further modified with reference to the remaining lines now projected or actually under construction. It is the general purpose of these changes to make the new lines serve as feeders instead of competing lines to the Antofagasta Railway.*

* *Bull.* of the Intern. Bureau of Am. Republics. Jan., 1909, p. 111 *et seq.*

(To be continued.)

THE EXPLORATION OF THE UPPER AIR*

BY

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Much light has been thrown upon the movements and conditions of the higher atmosphere by observations made upon mountain summits, such as Ben Nevis, and we hope that some day there will be again a high-level station somewhere in the British Isles—supported by Government. It is indeed true that observations made upon mountain peaks and those obtained from some point in the free atmosphere represent different sets of conditions, and that the presence of the mountain itself affects the records. For example, it is probably true, as a rule, that the air on a mountain summit is

* This excellent summary of the nature and results of researches in the free atmosphere, made during the past few years, is reprinted from the annual *Journal* of the Scottish Meteorological Society, Edinburgh, Vol. 15, 3d Series, No. 26. The footnotes give references to publications in which may be found the original accounts of these researches. The *Bulletin* is indebted to Mr. Watt and the Scottish Meteorological Society for the opportunity to reprint this paper dealing with, perhaps, the most brilliant chapter in the history of meteorology.

distinctly colder than that at a point at an equal height in the free air close by. But we are not aware that any advocate of high-level stations has claimed that mountain observations should be regarded as identical with those made in the free atmosphere; and the fact remains that, as a rule, of all observations made at a considerable height, only those obtained from some point on the earth's surface could be reported to a central office in time to be charted on the current Daily Weather Map, and examined in connection with simultaneous low-level readings within an hour or two of the time of observation. On the other hand upward soundings in the free atmosphere are restricted neither by latitude nor by longitude, and many observations have been obtained from points at more than twice the height of Everest above the level of the sea. Modern meteorology has become a science dealing with space of three dimensions.

The exploration of the free atmosphere has been conducted by means of—(1) kites; (2) manned balloons; (3) "ballons sondes," or balloons carrying self-registering instruments only. Pilot-balloons carrying no instruments, and liberated merely to show the drift of the upper-air currets, are also used. It will be convenient if we give brief historical notes on the development of these various agencies.*

First of all, as regards kites. It is commonly supposed that Benjamin Franklin, in his famous experiments for collecting atmospheric electricity, made at Philadelphia in 1752, was the first to use the kite for scientific purposes. But that is not the case, for, three years earlier, Dr. Alexander Wilson, Professor of Practical Astronomy in the University of Glasgow, had used kites to raise thermometers in the air in an attempt to investigate the temperature at different heights.† Apparently nothing further was done until towards the middle of the nineteenth century, when Espy, in America, did some useful work. Later, in the eighties, Archibald, in England, experimented extensively on the best form of kite, and was the first to use pianoforte steel wire, which was at once stronger, smaller, lighter, and cheaper than that of copper and iron, formerly used. But it was not until Mr. A. L. Rotch took up the matter at his private observatory on Blue Hill, near Boston, in Massachusetts, that a systematic investigation of the upper air by means of kites was anywhere attempted. That now famous observatory was

* Anyone dealing with the history of the subject must be greatly indebted to A. L. Rotch's "Sounding the Ocean of Air." (London: Society for promoting Christian Knowledge.)

† *Trans.* Roy. Soc. Edin., vol. x. part ii. pp. 284–286.

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founded by Mr. Rotch in 1885 on ground purchased by him, and for more than twenty years reports of the various investigations have been published by Harvard University. Kites were first employed in 1894, and since that time a continuous survey of the atmosphere up to a height of about two miles has been conducted, yielding results of the greatest value. The kites employed at Blue Hill are of a modified Hargrave or box pattern, and the Blue Hill type has been very generally adopted elsewhere.* As a rule, two or more kites linked together are used, and, as far as we are aware, the highest observations ever secured by means of kites were made by a team of six from Lindenberg, near Berlin, in November, 1905, when an elevation of about 21,000 feet was reached.†

In 1901 the exploration of the atmosphere by means of kites received a great impetus. The method had obviously its limitations; there might be too much wind or too little, and an extensive kite campaign organized by the Weather Bureau of the United States of America was not a complete success owing to the lightness of the winds experienced.‡ It was found that at a land station kites could be raised only in a wind of twelve miles per hour, and that in calm anti-cyclonic weather they were of but little use. Mr. Rotch now suggested that from a steamer, where even in calm weather there was always an artificial wind equal to at least the speed of the steamer, kites could be flown in all weathers, since the lifting powers of strong winds could be modified by steaming against or at an angle to them; and Mr. Rotch, after some preliminary experiments, himself demonstrated the value of his suggestion by making some very successful kite flights in crossing the Atlantic in the steamship *Commonwealth* at the end of August, 1901.§

This enterprise may be said to have been the inspiration of the recent energetic work in England in upper-air meteorology, for Mr. Rotch's account of his experiments to the British Association at Glasgow (September, 1901) made such a deep impression that a grant was voted to initiate experiments by means of kites, and a joint committee of the Association and of the Royal Meteorological Society was appointed to administer the grant.‖ This committee, with Dr. Shaw as chairman, and Mr. W. H. Dines as secretary, has

* For accounts of founding of Blue Hill Observatory, introduction of kites, description of apparatus and methods, and results, see *Annals* of the Astronomical Observatory of Harvard College, especially vols. xx. part i., xlii. part i., and xlviii. part i.

† *Ergebnisse der Arbeiten des Königlich Preussischen Aeronautischen Observatoriums* (1905), Band i. p. 63, Berlin, 1906.

‡ U.S.A. Weather Bureau, Bulletin F.

§ *Nature*, vol. lxv. pp. 4, 545.

‖ *British Association Reports*, 1901–1908,

been reappointed from year to year, though latterly without a grant. Aerial research in the British Isles is greatly indebted to the vigorous work of the Royal Meteorological Society, whilst during the last four years the Meteorological Committee have assigned a considerable sum for the work, with Mr. Dines as their official investigator. The first soundings of the free upper air in this country were made by Mr. Dines from a small steamboat at Crinan in the summer of 1902, that place recommending itself by its comparative seclusion and its proximity to the Atlantic and to Ben Nevis, and the Crinan ascents have been continued in succeeding summers. It is probably a sign of the times that one of the younger universities has been the first to associate itself with meteorological research in England, for the Physical Laboratory of the University of Manchester has established at the Howard Estate, on Glossop Moor, a well-equipped station for the investigation of the upper air. Since the Meteorological Office has associated itself with the work, results of ascents from various stations are published with remarkable promptness in the *Weekly Weather Report,* so that within a few days of the close of each week there is available a very full account of the low-level meteorological conditions of the week, and also a considerable amount of information as to the conditions at higher levels. At present there are, as a rule, reports from the Glossop Moor station; from Mr. Dines at Pyrton Hill, in Oxfordshire; and from two enthusiastic private observers—Mr. C. J. P. Cave, of Ditcham Park, and Mr. S. H. R. Salmon, of Brighton.*

We pass now to the use of balloons in aerial meteorology. The effective history of ballooning begins with the work of the Montgolfier brothers in France towards the end of the eighteenth century. In 1783, an ascent was made in a "Montgolfière," or heated-air balloon; in the same year the physicist Charles reached an elevation of 9,000 feet above Paris by means of a balloon filled with hydrogen gas; and two years later the Channel was crossed from the English side by a Frenchman and an Englishman in company. Very early the balloon was recognized as of great value for scientific research, and in the early years of last century some well-known names in French science were associated with scientific ballooning. Thus, in 1804, Gay-Lussac reached a height of 23,000 feet, making magnetic and temperature observations. In England, in the fifties, John

* For accounts by Mr. Dines of his methods and instruments, see the *Quarterly Journal* of the Royal Meteorological Society, vol. xxix. (1903) p. 65, and vol. xxxi. p. 217; and for various reports on upper-air work, that *Journal*, vols. xxviii. 1, xxx. 155, xxxii. 15 and 29, xxxiv. 15, xxxv. 15 and 37. See also the *Reports of the British Association*, 1902 *et seq.*, and the *Annual Reports of the Meteorological Committee*, especially the Third Report (1908), pp. 43–49.

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Welsh, of Kew Observatory, made some important ascents; and then we come to the splendid work of James Glaisher, who, along with Coxwell, the aeronaut, made about thirty ascents between 1862 and 1866, which are described in great detail in the Reports of the British Association. A height of 23,000 feet was thrice exceeded, and on one memorable occasion, from Wolverhampton, on 5th September, 1862, a height of more than 29,000 feet was reached, both Glaisher and Coxwell losing consciousness at that great elevation. Various considerations, such as a comparison of the rate of ascent when he lost consciousness, and the rate of descent when he recovered consciousness, thirteen minutes later, and the fact that "a very delicate minimum thermometer read minus 11°.9 (F.), led Glaisher to the conclusion that a height of 36,000 or 37,000 feet, or fully seven miles, had been reached. This, however, seems doubtful; but, in any case, Glaisher's great feat has been equalled or excelled only in Germany.*

It may be said that aerial research by means of manned balloons in England since Glaisher's ascents of more than forty years ago has been merely spasmodic, and, though other countries have had some small share in research by this means, in Germany alone has this method of work been vigorously pursued. The use of manned balloons obviously involves great expense, and Germany has now in the Imperial Aeronautical Observatory at Lindenberg, near Berlin, of which Dr. Assmann is the distinguished director, by far the most elaborate place of the kind in the world. The German School of Scientific Aeronautics has given great attention to the best exposure of instruments, and the "aspiration psychrometer" of Dr. Assmann has solved a serious difficulty. Thus the temperature readings obtained at great heights by Glaisher were higher than one would *à priori* have expected, and it is now recognized that his thermometers were probably not sufficiently protected from the direct rays of the sun, and that in any case the car of the balloon in which the instruments hung became in its rapid ascent practically a well of relatively warm air which had not time to acquire the true temperature of the various strata through which it passed. These difficulties are entirely overcome by using a properly exposed Assmann psychrometer, in which a fan driven by clockwork ensures a proper circulation of air round the bulbs of the thermometers.

Some great heights have been reached on the German balloon ascents, and that of 31st July, 1901, from Berlin, on which Süring and Berson reached a height of 10,800 metres, or about 6¾ miles,

* *British Association Reports*, 1862–1866.

probably represents the extreme altitude attainable by human beings even with the help of artificial means of respiration. On this remarkable voyage the balloon was in the air for seven and a half hours, and came to earth nearly ninety miles from Berlin. Both observers fainted before the highest point was reached, which was determined from a barograph trace, and made their last temperature observation at a height of 10,225 metres, or about 33,500 feet, that is at a point more than 4,000 feet above that at which Glaisher and Coxwell lost consciousness. The temperature at this point was —39°·7 C. (—39°·5 F.), and already at a much lower level the aeronauts found it "empfindlich kalt."

The German upper-air work has been of the most thorough description and affords perhaps the only available material for a thorough study of day-to-day temperature changes in the free upper air.*

Whilst Germany may be said to have perfected the use of the manned balloon, and America, or perhaps rather an American, the use of the kite, to M. Teisserenc de Bort, of Trappes, near Paris, falls the credit of having perfected the use of the "ballon sonde," by which the free atmosphere has been explored to an amazing height. It is true that already, in 1892, MM. Hermite and Besançon had sent up to considerable heights balloons made of gold-beater's skin and carrying simple instruments,† but it remained for M. de Bort to fully develop this method, and in 1898 he made some important discoveries by means of large paper balloons covered by a net. Meanwhile Dr. Assmann in Berlin was experimenting with small rubber balloons such as are now universally employed. These are inflated with hydrogen gas only sufficiently to give them an initial upward velocity, and as pressure goes on diminishing with increase of height the gas expands till a point is reached when the balloon bursts, gradually falling to the ground under the protection of a parachute. Though these balloons often travel great distances, the instruments are recovered in a surprising number of cases, and some remarkable elevations have been reached, occasionally more than sixteen miles. M. de Bort's methods have been followed in many countries, and by means of "ballons sondes" the ocean of air has been sounded to

* See "The temperature of the Air above Berlin from 1st October, 1902, until 31st December, 1903, as shown by the Daily Ascents executed by the Aeronautical Observatory of the Royal Meteorological Institute of Prussia." By Professor Dr. Richard Assmann (Berlin), 1904.

Ergebnisse der Arbeiten am Aeronautischen Observatorium. (4 vols. Berlin, 1902–1905).

Ergebnisse der Arbeiten des Königlich Preussischen Aeronautischen Observatoriums bei Lindenberg. (3 vols., Berlin, 1906–1908).

† *Comptes Rendus* Paris [C.R.], vol. cxv. p. 862.

great heights at many places from St. Petersburg in the east to St. Louis in the west, and from the Arctic Circle to the Equator.

It remains to add that observations of the direction of cirrus clouds have told us a great deal about the movements of the upper air at great heights, and that much useful work has been done by means of pilot balloons.

We have now indicated the various methods by which the exploration of the upper air has been carried on, and may now briefly describe some of the results, dealing chiefly (1) with researches made on the general circulation of the atmosphere, and (2) with investigations of the temperature conditions of the atmosphere at great heights.

When Rotch described to the British Association in 1901 his own successful experiments on the use of kites at sea, he suggested the trade-wind region of the North Atlantic as a promising field for research. You have there the more or less permanent North-East trade, flowing down to the thermal equator where there is a great uprush of heated air, and the problem offered is as to how exactly this air is transferred again to higher latitudes. However, before Rotch himself had an opportunity of exploring the region, Professor Hergesell of Strassburg had secured the co-operation of the Prince of Monaco, and in the summer of 1904 made a cruise of investigation in the *Princesse Alice*. The field covered was the part of the North Atlantic bounded by Spain, the Azores, and the Canaries, and much important information was obtained as to the variation of temperature and humidity with height, etc. One result, however, was of a most unexpected nature. It had long been held that above the North-East trades there flowed the "anti-trade," or return current, from the South-West; and the fact that the prevailing wind on the Peak of Teneriffe, some 12,000 feet high, was from that point confirmed this opinion. Hergesell, however, though his upward soundings on several occasions reached a greater height than 12,000 feet, found no indication of the upper "anti-trade," and concluded that the South-Westerly current observed on the Peak of Teneriffe was due to local influences.*

Hergesell's conclusion was so unexpected that it seemed to Rotch and De Bort an urgent matter that further investigations should be conducted, and, in the following summer (1905), they organized an expedition in the steam yacht *Otaria*,—Mr. Clayton of the Blue Hill Observatory and M. Maurice of Trappes acting as meteor-

* *C.R.*, cxl., 331.

ologists. A leisurely voyage was made from the Mediterranean by way of Madeira, the Canaries, and the Cape Verde Islands, as far as latitude 10° N., returning by way of the Azores. Many kite flights were made up to a height of more than a mile, and the wind direction at great heights was observed by means of pilot balloons whose trajectories could be followed up to a height of six or seven miles.† The general result of the expedition may be summed up as follows: The existence of the South-West anti-trade, which theory demanded and the winds on the Peak of Teneriffe indicated, was absolutely confirmed. It was found, however, that the variation of wind direction with height was not altogether simple, and that there was not an immediate transition from a North-Easterly to a South-Westerly direction. The North-East trade was found to be of varying thickness; above that was a layer of North-Westerly winds; and above that the return current up to a height of at least six or seven miles, with a direction varying from South-East to South-West. It was found that the velocity of the trades decreased rapidly with height. Further voyages were made by the *Otaria* in 1906 and 1907 into mid-Atlantic and as far South as Ascension.‡

We may here conveniently point out that earlier theories of the general circulation of the atmosphere, which conceived that part at least of the upper return current from equatorial regions extend to the pole, have been disproved by systematic observations of the direction of the high cirrus clouds in higher latitudes. For it has been shown that in the temperate zone in both hemispheres there is a general motion of the upper air from West to East; indeed, this drift towards the East has been found at least as far North as the Arctic Circle. And to the South of the Equator we have the South-Easterly trades underlying the North-Westerly anti-trades, as has been fully proved by observations of the direction of the upper clouds over Mauritius. Above the region of equatorial calms there flows a steady upper current from the East, as was demonstrated in the most striking manner after the eruption of Mount Krakatoa in August, 1883, for "the optical phenomena caused by the volcanic dust which was carried up into the uppermost layers of the atmosphere travelled round the world from East to West in about twelve or thirteen days, from which it follows that these uppermost currents are endowed with a velocity from the East of eighty-three miles per hour. This velocity is very nearly the same as the mean

* *Nature*, vol. lxxii. 244, lxxiii. 54.
† *Nature*, vol. lxxx. 219.

velocity of the upper clouds at Washington, and is therefore not at all inconceivable."*

But we cannot leave this part of our subject without referring to an aerological expedition sent out to tropical East Africa in the summer of 1908 by the Royal Prussian Aeronautical Observatory at Lindenberg, though only a sketch of the work done is as yet available. The enterprise, official and private, that despatched such an expedition into the heart of a tropical continent must command the highest admiration. Professor Berson was the leader, and the greater part of the work was conducted from the shores and waters of Lake Victoria Nyanza. A full report of the various researches will be looked forward to with the greatest interest, and it is certainly a very surprising fact that whilst the regular Easterly upper current of the equatorial regions was found, there was on several occasions "an uppermost current of air flowing from due West."†

Passing now to the chief results of studies of temperature conditions in the free atmosphere, we may at once discuss the remarkable discovery by M. de Bort of the so-called "isothermal layer." It was known that temperature inversions occurred, in certain circumstances, on the surface of the earth. Especially is this the case during anti-cyclonic weather in winter, and as an extreme example we may instance a striking departure from the normal relationship between the summit and the base of Ben Nevis that occurred during the great frost of January and February, 1895. The average difference of temperature between Ben Nevis and Fort William ranged from 16°·8 F. in April to 14°·4 in December, the mean for the whole year being 15°·4, whilst at 9 A. M. on 19th February, 1895, the summit was no less than 17°·6 *warmer* than the base. (B.N.O., 33°·6, F. W. 16°·0.)‡

When we pass from the surface of the earth to the free atmosphere we find that there also inversions are met with at moderate and varying heights up to a level of some two miles or more, that is throughout the region in which nearly all clouds except the cirrus are formed. Above this comes a much thicker layer, in which temperature decreases with remarkable regularity, and the ascents of kites and manned balloons had given no indication that this decrease did not go on indefinitely. M. de Bort, however, had not been long at work at Trappes with his "ballons sondes" when he was

* See Dr. Hildebrandsson's Report to the Permanent International Meteorological Committee on "The International Observations of Clouds," translated in *Quarterly Journal*, Royal Met. Soc., vol. xxx, pp. 317–343.

† *Nature*, vol. lxxx. p. 171.

‡ See a communication by the writer in *Nature*, vol. lxxi. 583.

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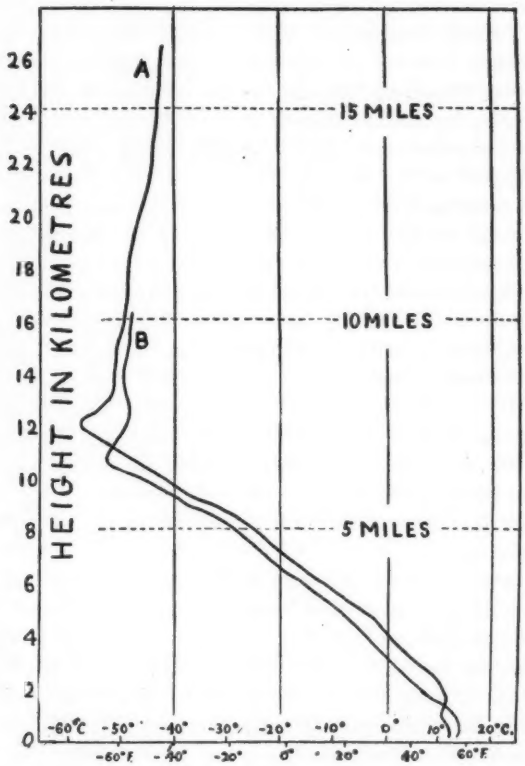
able to make the announcement that after a certain height, varying from five to nine miles, the fall of temperature ceases and is very often actually reversed. This uppermost region he proposed to call the "zone isotherme," and probably the title "isothermal layer" generally adopted in England has come to stay. It is not, however, altogether satisfactory, as the region indicated is seldom more than approximately isothermal. Moreover it is inappropriate to describe as a layer a region of which the uppermost limit has not yet been reached.*



TEMPERATURES OBTAINED ON "BALLONS SONDES" ASCENTS.

The phenomenon of the "isothermal layer" is well shown in the temperature records obtained on two characteristic "ballon sonde" ascents which are charted in the accompanying diagram. The

* *C.R.*, cxxxiv. 987, cxxxviii. 42, cxlv. 149.

Belgians have been very successful in reaching great elevations, and the curve marked A refers to an ascent made from Uccle, near Brussels, on 25th July, 1907, when a height of fully twenty-six kilometres, or more than sixteen miles, was attained. Curve B refers to an ascent made from Trappes two days earlier. It will be observed that in both cases an inversion of temperature occurred near the ground, followed by a long gradual decrease of temperature with a sudden change of gradient at a great height. In A the lowest temperature recorded occurred before the balloon had reached more than half its extreme elevation, and at a height of fifteen miles the temperature was as much as 14° C. (25° F.) higher than at seven and a half miles.

As a further illustration of the phenomenon of the "isothermal layer" we give below actual numerical results obtained on another high ascent from Uccle on 5th November, 1908.* Two rubber balloons in tandem were employed, as is very commonly done, and these remained in the air for nearly two hours, and were recovered at a place about fifty miles to the SSE. The greatest height reached was 29,040 metres, or about eighteen miles, and the lowest temperature, —67°·8 C. (—9°·0 F.), was experienced at 12,950 metres, or about eight miles, that is before the balloon had reached more than half its extreme elevation, as was also the case on the ascent referred to in curve A of our diagram.

Height.		Temperature.		Height.		Temperature.	
Metres.	Miles. (Approximately.)	C°.	F°.	Metres.	Miles. (Approximately.)	C°.	F°.
100	....	4.4	39.9	12,000	7.5	—64.3	—83.7
500	....	3.9	39.0	13,000	....	—67.6	—89.7
1,000	....	1.7	35.1	14,000	....	—65.0	—85.0
1,500	....	—3.3	26.1	15,000	....	—64.8	—84.6
2,000	....	1.2	34.2	16,000	10.0	—64.1	—83.4
2,500	....	—0.2	31.6	17,000	....	—63.6	—82.5
3,000	....	—3.2	26.2	18,000	....	—62.9	—81.2
4,000	2.5	—8.7	16.3	19,000	....	—62.6	—80.7
5,000	....	—14.4	6.1	20,000	13.0	—62.6	—80.7
6,000	....	—21.4	—6.5	21,000	....	—62.3	—80.1
7,000	....	—28.3	—18.9	22,000	....	—62.1	—79.8
8,000	5.0	—36.2	—33.2	23,000	....	—61.8	—79.2
9,000	....	—44.3	—47.7	24,000	15.0	—62.3	—80.1
10,000	....	—52.0	—61.6	25,000	....	—62.5	—80.5
11,000	....	—58.4	—73.1	26,000	16.2	—62.7	—80.9

Thus a well-marked temperature inversion occurred at the height of 1,500 metres, and after a height of thirteen kilometres, or

* *Ciel et Terre*, 1st January, 1909.

about eight miles, there was a decided rise of temperature for a considerable distance. During the last five miles of the ascent variations were but slight.

It may be pointed out that De Bort's discovery of the isothermal region had, in a way, been anticipated by MM. Hermite and Besançon. They, however, could not believe in the actual existence of a region of relatively warm air at a great height, such as was apparently indicated by their instruments, and considered that their observations became unreliable in the rare upper air, owing to the effect of the intense solar radiation there experienced.* But M. de Bort submitted to the Academy of Sciences of Paris in 1902 an exhaustive account of his researches, and expressed the confident opinion that the unexpected results of temperature observations at great heights represented a physical fact. He had indeed been satisfied of this some years earlier, but had carefully improved his methods, in particular devising means of regulating the speed of ascent of the balloons, so that the instruments should have time to accommodate themselves to the varying temperature conditions of successive heights. Moreover, his ascents at Trappes had been made at night, so as to avoid the direct effect of solar radiation. Taken along with experimental work by Professor Assmann in Germany, M. de Bort's researches placed the reality of the isothermal layer beyond doubt. Quite recently the matter has been thoroughly discussed in an interesting correspondence in the columns of *Nature* (vols. lxxvii.-lxxx.).

M. de Bort's work has been followed up in many countries. He himself, in 1907, organized an expedition to Kiruna, in Lapland, just within the Arctic Circle, and there, too, the isothermal layer was found to exist.† It had been found, too, many times in England; in several countries of the continent of Europe; in America, from St. Louis, by Mr. Rotch; by Professor Hergesell and the Prince of Monaco, in the neighborhood of the Azores; and on the cruises of the *Otaria,* as far south as 25° N. It had, however, not been found to the south of that parallel, though aerial soundings over the equatorial Atlantic had several times exceeded 15 kilometres.‡ M. de Bort, therefore, regarded the phenomenon as universal, except as regards the tropics. Now, however, even that restriction may be removed, for on the German expedition of last year Professor Berson found the upper temperature inversion on several occasions at great heights over tropical East Africa.§

C.R., cxvi. 766. †*C.R.*, vols. cxlv. 149. ‡*Nature*, vol. lxxx. 219. §*Nature*, vol. lxxx. 171.

In one of his earliest communications, M. de Bort had pointed out that the height of the isothermal layer varies with variations of the sea-level pressure distribution, lying nearer to the ground than its average height over a low-pressure area, and farther from the ground above high-pressure areas. And what is true as regards a particular point, is true on a larger scale, for there appears to be a gradual increase in the average height of the layer as we pass from the lower pressure of the polar regions into the heart of the Atlantic anti-cyclone. In America, Rotch's investigations from St. Louis, in Lat. 35° N., showed that there the warm stratum is "at a decidedly higher altitude than it is in Northern Europe."*

Another remarkable discovery in connection with the higher atmosphere is the fact that at a height of five or six miles the day-to-day changes of temperature are more important than at the surface of the earth; variations of 30° F., or more, may occur with a low-level variation of but a few degrees. De Bort gives a striking example from the results of simultaneous ascents made from Paris and from Hald in Jutland. On 14th March, 1903, the temperature of the upper air over the two places at a height of about two and a half miles was the same,—about 3° F. On the following day, temperature at the same elevation over Paris had fallen about 2°; over Jutland, it had dropped to 36° below zero, a fall of about 40°; whilst the surface temperature at both places had varied but slightly. "Such facts show that we cannot theorize on atmospheric phenomena as if they were continuous in time and space; such cases, on the contrary, are rare, and limited to certain atmospheric conditions."

Lastly, it has now been demonstrated that the geographical distribution of temperature in the upper air is very different from that at the earth's surface. Surprisingly low temperatures were found at great heights over the North Atlantic, and Berson found over equatorial East Africa, at an elevation of about thirteen miles, a temperature of —119° F., "a lower temperature than ever registered at equal or even greater heights in Europe!" On the other hand, the upper-air temperatures above the Arctic Circle were found to be very high. We quote M. de Bort—

". . . In the lower layers the temperature of the equatorial zone exceeds that of the Arctic regions by 25° C. (45° F.). This excess of temperature decreases as the altitude increases until at a height of 10 or 11 kilometres it is as warm over the Arctic Circle as it is over the equatorial zone. With further increase in height there is no further decrease in temperature over the Arctic Circle, because

* *British Association Report*, 1908, p. 594.

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the isothermal region is reached. But in the neighborhood of the Equator rapid decrease of temperature with increasing altitude still continues; the temperature becomes less therefore over the Equator than it is at the same height over the Arctic Circle. . . . There are indeed some days when the polar temperatures are lower than the equatorial, but this is a temporary phenomenon which occurs at the coldest time of the year. In equatorial regions, on the contrary, if one considers as the point of departure the region where the trade-winds meet near the thermal equator, there is, strictly speaking, neither winter nor summer. . . . Thus during the greater part of the year it is sensibly colder by 10° or 20° C. in the equatorial regions at altitudes of 15 or 16 kilometres than in Arctic regions. This fact, anticipated by me some years ago, deserves to be taken into serious consideration in theories relating to the general circulation."*

The explanation of the phenomenon of the "isothermal layer" involves physical problems of great difficulty, and we can merely refer to the work of Gold† in England and Humphreys in America.‡ The latter points out that the abruptness of the change of temperature gradient at the entrance to the region of relatively warm air is probably due to the existence at the critical level of a more or less well-defined veil of cirrus cloud, and shows that when the veil is fully formed the increase of temperature is rapid, whilst with a clear sky the reversal of gradient is more gradual. As regards Gold's researches we repeat from our last issue a summary of his remarks at the Dublin (1908) meeting of the British Association, which indicates the ground covered by the paper referred to below:

"Any theory of the isothermal layer must be primarily concerned with the absorption and emission of heat radiation by the atmosphere. The streams of radiation entering any layer were four—the solar radiation, the radiation from the atmosphere above the layer, the terrestrial radiation, and the radiation from the atmosphere below the layer. If the total amount of these four streams absorbed by the layer was less than the radiation emitted, its temperature must fall, and there would be the possibility of convective equilibrium. But if the absorption exceeded the emission, the temperature of the layer would rise, and there would be no possibility of convective currents penetrating from beneath. By utilizing the experimental results of Langley, Paschen, and others to obtain an estimate of the absorptive power of the atmosphere, he had calculated the intensity of radiation entering any layer and the amount absorbed there. The application of the results to our atmosphere led to the results that, if the air were divided into two layers, the lower in adiabatic, the upper in isothermal equilibrium, the upper layer must extend as low down as 10 kilometres, where the pressure was one-quarter of that at the earth's surface, and it could not extend below 4½ kilometres, where the pressure was one-half that of the earth's surface. A further result

* *British Association Report*, 1908, p. 641.

† "The Isothermal Region of Atmosphere and Atmospheric Radiation." By E. Gold, M.A. *Proceedings* of the Royal Society, A. vol. lxxxii. pp. 43–70.

‡ "Vertical Temperature Gradients of the Atmosphere, especially in the Region of the Upper Inversion." By Prof. W. J. Humphreys. *Bulletin of the Mount Weather Observatory*, vol. ii. part 1.

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obtained was that it was impossible for there to be a temperature as low as —100°C. at any point of the atmosphere."

Any student of the subject must also refer to theoretical researches made twenty years ago by M. de Bort, who calculated from the pressure and temperature at the earth's surface the isobars at a height of 4,000 metres (about 2½ miles). He showed that most of the areas of high and low pressure observed near the ground become quite effaced at higher levels, where there is a much less complex pressure distribution.*

* See *Annales du Bureau Central Météorologique*, 1887 and 1888.

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Note.—Since the above paper was passed for press, there has been published a valuable report, communicated to the British Association (Winnipeg, 1909) by Messrs. E. Gold and W. A. Harwood, on "The Present State of our Knowledge of the Upper Atmosphere as obtained by the use of Kites, Balloons, and Pilot Balloons." The title of Advective Region is suggested for the so-called "Isothermal Layer," and M. de Bort has suggested Stratosphere as a suitable title. In contradistinction, that portion of the atmosphere below the "Isothermal Layer" would be known as the Convective Region, or Troposphere.

There will be presently published by the Meteorological Office a report on "The Free Atmosphere in the Region of the British Isles," in which Mr. Dines gives a full account of his instruments and methods, and Dr. Shaw discusses "The Perturbations of the Stratosphere."

November 1909.

THE HIGHEST BALLOON ASCENSION IN AMERICA

Dr. A. Lawrence Rotch has a short account in *Science* (No. 766) of the results of balloon experiments in our eastern states in 1908. His statement follows:

"Although a large number of *ballons-sondes* were despatched from St. Louis in 1904-7 under the direction of the writer, none had been employed in the eastern states until 1908. In May and July, that year, four *ballons-sondes* were launched from Pittsfield, Mass., with special precautions to limit the time they remained in the air and to prevent them from drifting out to sea with the upper westerly wind. Three of the registering instruments have been returned to the Blue Hill Observatory with good records. The first instrument sent up on May 7 was not found for ten months and the record,

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forming the subject of the present article, is very interesting because it gives complete temperature data from the ground up to 17,700 meters, or 11 miles. This is 650 meters higher than the highest ascension from St. Louis, which, by a coincidence, was also the first one to be made there. On May 7 a general storm prevailed, so that the balloon, travelling from the east, was soon lost in the cloud and its subsequent drift could not be followed, but the resultant course was 59 miles from the southwest, as determined by the place where the instrument fell two hours later.

"At the ground the temperature was 4°.5 C., and this decreased as the balloon rose to the base of the cloud, which itself was considerably warmer than the underlying air.

"Above the cloud the temperature continued to fall with increasing rapidity up to a height of 12,500 meters (nearly eight miles) where the minimum of —54°.5 C. was registered. Here the great warm stratum was entered and penetrated farther than ever before in this country, namely, to the height of 17,700 meters, where the temperature was —45°.6 C. An increase of 10° occurred, however, in the first 3,000 meters, for above 15,500 meters nearly isothermal conditions prevailed, confirming the belief of Teisserenc de Bort that what he calls the "stratosphere" is composed of a lower inverting layer with isothermal conditions above extending to an unknown height. In an ascension last November in Belgium the relatively warm stratum was found to extend from 12,900 meters to the enormous height of 29,000 meters, or 18 miles, where there was still no indication of its diminution."

GEOGRAPHICAL RECORD

THE AMERICAN GEOGRAPHICAL SOCIETY

MEETINGS OF THE SOCIETY. A special meeting of the Society was held on Monday evening, Dec. 6, 1909, at the Engineering Societies Building, when Commander Robert E. Peary, U. S. N., delivered an address on "The Discovery of the North Pole." The Hall was crowded and many were unable to gain admittance. President Huntington, in introducing the explorer, said:

"It is my great privilege this evening to introduce to you, not alone the man whose unwearied efforts have so wonderfully broadened our knowledge of the world, but the man who by his own choice and the sacrifice of the best he had to give—the years of his life—becomes for us a type and expression of our own aspirations. The endeavor of Commander Peary is a demonstration in an individual of the idealism of our race; that eager willingness to face all chances that the sign manual of humanity may be placed on the outermost edge of the

humanly attainable. Such work is a vindication of immortality—a defiance to time."

Commander Peary showed a large number of lantern views illustrating his last expedition, from the passage of the *Roosevelt* through the Smith Sound Channels to its winter quarters at Cape Sheridan, the sledge route to Cape Columbia which was the starting point for the journey of 475 statute miles to the North Pole, and many phases of the eventful march over the sea ice, such as hauling the sledges across the pressure ridges, the ice huts at the camps, the method of taking observations for position, ice scenes at the Pole, etc. His address was the condensed story of the great achievement which, as he said, was the result of the perfected organization, methods and material growing out of many years of experiment and study.

A regular meeting of the Society was held at the Engineering Societies' Building, No. 29 West Thirty-ninth Street, on Tuesday evening, Dec. 21, 1909. Vice-President Greenough in the chair.

The following persons, recommended by the Council, were elected to Fellowship:

Frank Bailey,
John L. Cadwalader,
Ramon Cuiteras,
Alfred W. Hoyt,
Charles P. Huntington,
Jesse Albert Locke,
James Marwick,
Eugene Meyer, Jr.,
Charles L. Parmelee,
Charles W. Parsons,
William L. Porter,
Rev. Philip M. Rhinelander,
Thomas Shaw Safe,
Charles W. Seabury,
Dr. Louis Livingston Seaman,
Jefferson Seligman,
Morris W. Seymour,
Miss Anna Riker Spring,
James Gordon Steese,
R. F. Warner.

The Chairman then introduced Professor Charles Ernest Fay of Tufts College, who addressed the Society on "Across Uganda to the Mountains of the Moon." Stereopticon views were shown.

On motion, the Society adjourned.

Honors Awarded. At a meeting of the Council of the Society, on Dec. 16, the Cullum Medal was awarded to Mr. Ernest H. Shackleton, the Antarctic explorer, who, on Jan. 9, 1909, after a long journey southward over the Barrier Ice and the Antarctic continent, reached a point within 97 geographical miles of the South Pole.

At the same meeting, the Council awarded the Daly medal to Mr Charles Chaillé-Long, who, in 1874, navigated the Victoria Nile, discovered Lake Ibrahim and completed the proof that the river issuing from Victoria Nyanza is the Nile.

NORTH AMERICA

Relief Model of Illinois. The Geological Department of the University of Wisconsin has prepared a geological relief model of Illinois for the University of Illinois. Its horizontal scale is five miles to an inch and vertical scale, 1,320 feet to one inch. The model is six feet seven inches by three feet nine inches. The topography is based upon the contour maps prepared in 1892 under the direction of Prof. C. W. Rolfe for the Chicago World's Fair and upon the

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topographic maps of the United States Geological Survey, the Mississippi River Commission, etc. The geology is mostly from the geological map prepared by Prof. Stuart Weller for the Illinois Geological Survey.

THE GEOLOGIC MAP OF NORTH AMERICA. The Geological Society of America, at its meeting in Ottawa, in 1905, appointed a committee to prepare a general geological map of North America. The committee consisted of the late I. C. Russell (chairman), J. G. Aguilera, Bailey Willis, F. D. Adams, and C. W. Hayes. The completed map and two explanatory pamphlets by Messrs. Willis and Aguilera were presented at the meeting of the Tenth International Geological Congress held in the City of Mexico in September, 1905. Though the map was criticised in some respects, it was the first adequate step towards the filling of a long-felt want, and the map has served a very useful purpose. The U. S. Geological Survey has recently been revising the map with a view to republication, and the preliminary draft of the new map is now ready for inspection, by all who are interested, at the office of the Survey in Washington.

STATE GEOLOGICAL AND NATURAL HISTORY SURVEY OF CONNECTICUT. The Third Biennial Report (Bull. 12) recapitulates what has been done, the work in progress and the future work in geology. The two subjects of investigation are the geology and the natural history (botany and zoölogy) of the State. The geological investigations relate chiefly to surface geology or the study of the phenomena connected with the work of the great ice sheet of the Glacial period. Apart from the problems of surface geology, the area most thoroughly studied is that of the Triassic formation. The area where detailed work is most deficient, as yet, is that of the eastern crystallines. But there is more necessity, at present, for the more detailed study of the surface geology than that of the underlying rocks.

TIDE TABLES FOR THE EASTERN COASTS OF CANADA FOR 1910. These tables prepared by Dr. W. Bell Dawson have been issued by the Tidal and Current Survey, Department of Marine and Fisheries, Ottawa. The data on which the tables are based have been obtained by means of self-registering tide-gauges that are constantly in operation. As these observations have been kept up for a long time, it is found that the tables deduced from them are sufficiently accurate to be very useful. The records of the tide-gauges are reduced by the latest methods of obtaining the tidal constants, and from these the tables are calculated by the Nautical Almanac Office in London.

SOUTH AMERICA

THE TUNNEL ACROSS THE ANDES. The *London Times* says that this tunnel was broken through in the last days of November and that by March it is expected to run trains between Buenos Aires and Valparaiso. The tunnel will be about three miles long, with the summit level of the railroad about 10,460 feet above the sea. The works at the Argentine end were begun in October, 1905, and the Chileans began their end of the tunnel a little earlier. The enterprise has been carried on under much difficulty owing to the nature and position of the rock. The tunnel was driven through the top of the mountain, which is composed of stratified rocks, tilted at a high angle, with some of the strata almost vertical. Owing to the constant percolation of melting snow, the rocks are decomposed to a great distance below the surface, especially along the planes of stratification and in fissures.

The rocks through which the eastern half of the tunnel was cut are chiefly limestones with beds of gypsum, layers of sandstone, some narrow clay bands, as if along the line of faulting, and some beds of conglomerate full of very hard, rounded water-worn pebbles and small boulders. Especially near the eastern end of the tunnel all joints and fissures are so decomposed that the rocks were found to be very loose.

Quite different conditions were found at the western end. The rocks there are mainly felspathic, with hard, tough clay in veins. These rocks endure much better than those of the eastern side, though they have many joints and cleavage planes. The western side of the mountains has the steeper slope and the rocks are much more solid. It was necessary, however, to line the tunnel throughout, for, though many of the rocks may in themselves stand the extremes of heat and cold, no dependence can be placed on any of the cleavage planes.

THE HEIGHT OF MOUNT HUASCARAN. Mrs. Fanny Bullock Workman has sent information to the press that in July last she despatched M. de Larminat and two other competent French topographers from Paris to Mount Huascaran, Peru, one of whose twin peaks was ascended in 1908 by Miss Anna Peck. They were to make scientific determinations of the height of these peaks. Mrs. Workman adds:

"They executed a careful and detailed survey from the sea to Yungay, and by actual measurement established the heights of four stations in the Black Cordillera, from each of which they triangulated the two peaks of Huascaran.

"The results are: Height of north peak, 21,812 feet; of south peak, 22,187 feet. These figures may vary by a few feet, but not many, when the calculations are finally gone over by M. Vallat for verification. Mount Aconcagua, nearly 22,900 feet, still remains, as I predicted, and as Sir Martin Conway and other Andean explorers have always maintained, the highest peak of South America."

AFRICA

DR. PÖCH'S STUDIES AMONG THE BUSHMEN OF SOUTH AFRICA. The Society has received a letter from Dr. R. Pöch announcing that he has finished his travels in the Kalahari and his studies of the Bushmen tribes. His researches were made under the auspices of the Imperial Academy of Science of Vienna. In 1907, he went to German Southwest Africa and reached the Kalahari Desert *via* Windhuk and Gobabis. The whole of 1908 was spent in "trekking" by ox wagon through the Kalahari, from west to east. At five points he stopped from three weeks to three months. Four different tribes were thoroughly studied: the Heillum, Aullein, Ai-khoe, and Ohê-khoe.*

Measurements, photographs, phonographic records, and cinematographic pictures were taken. The Kalahari Bushmen in their daily life and customs still exhibit the characteristics of their fathers, but in physical appearance they show their relationship to the Negro and the Hottentot. Some of their languages are closely related to that of the Hottentots.

The first half of 1909 was given to studies of the last remnants of the Cape Bushmen (Kham tribe), which is a much purer representative of the genuine Bushman, but is now almost extinct.

Dr. Pöch finished his researches with a second journey in the Kalahari.

* These names are not spelled here, according to Dr. Pöch's transliteration, as he employs some specially designed characters.

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Starting from Upington on the Orange River, he crossed the sand wastes to the north in different directions, reached Kuis in the Molopo Valley and travelled up the Nosob Valley nearly to the German border. South of the Molopo, he found the Nu, who are closely related to the Cape Bushmen. His journeys in the desert covered more than 2,000 miles and stretches up to 200 miles were crossed without water, men and animals quenching thirst only on watermelons. He is now at his home in Vienna, working out his materials.

ASIA

DISCOVERIES BY DR. LONGSTAFF. The recent expedition of Dr. Longstaff in the Himalaya made important discoveries which are reported in the *London Times* (Weekly edition, Dec. 24, 1909). He made for the Saltoro Pass, in the Karakoram, because he knew that the main axis of this western part of the Himalaya had never been crossed by any traveller between Younghusband's Mustagh Pass and the Karakoram Pass itself, a distance of 100 miles in a straight line. The name Saltoro Pass has been handed down by tradition, but there is no record of any one having crossed it and its exact position was uncertain.

When he and his companions crossed this pass (18,200 ft.), on June 15 last, they saw before them a huge glacier, bounded to the north and east by a lofty range of snowclad peaks. They found that this glacier was flowing south, though represented on the maps as flowing north. In September, Dr. Longstaff returned to this Siachen glacier (Saichar on the maps) and found it to be 44 miles long, instead of some 20 miles as had been supposed. It pierces the range that has hitherto been regarded as the main Karakoram axis.

The Siachen is thus shown to be the largest glacier in the Himalayan system and probably the largest outside the Alaskan and Polar regions, its only competitor being the Inytchek glacier in the Tian Shan. As the Siachen glacier drains into the Nubra River, the basin of the Indus must extend much further north than had been supposed. In short, the Indus-Yarkand water-parting here follows a chain of mountains not shown on any maps and some 20 miles north of the high range upon which it has been hitherto located.

Another very interesting discovery was that of a group of lofty peaks crowning this new chain of the Karakoram and culminating (about 35° 30′ N. Lat.; 70° E. Long.) in Teram Kangri, 27,610 ft. If the explorer's measurements can be accepted, this new peak is over-topped only by Mount Everest, K2, Kinchinjunga and Makalu.

POLAR

PEARY'S ATTAINMENT OF THE NORTH POLE. On Nov. 3, 1909, the Sub-committee of the Research committee of the National Geographical Society, Washington, reported that it had carefully examined Commander Peary's original journal, records of observations, instruments, etc., and was "unanimously of the opinion that Commander Peary reached the North Pole on April 6, 1909." A gold medal was awarded to him and another to Capt. Bartlett, the navigator of the *Roosevelt*.

DECISION ADVERSE TO DR. F. A. COOK'S CLAIM. The Committee appointed by the University of Copenhagen to consider the evidence upon which Dr. F. A.

Cook rested his claim that he had attained the North Pole on April 21, 1908, reported that the documents which he submitted afforded no proof that he had been to the North Pole.

CAPTAIN ROBERT F. SCOTT'S ANTARCTIC EXPEDITION. The British Government has promised $100,000 towards this projected expedition. About $60,000 has been raised by subscription and Capt. Scott says there is no doubt that the remaining $40,000 required will be obtained.

He expects to start south this summer and, in January or February next year, establish two bases on the Barrier Ice whose northern edge forms the Great Barrier Wall. One of these bases will be at South Victoria Land and the other at King Edward VII Land, about 450 miles apart. Each of these bases will be about 850 statute miles from the South Pole, and from them it is expected to make an extensive examination of the Barrier Ice; also, from one or another of them to make the journey to the Pole. Capt. Scott says that motor sledges and others drawn by ponies and dogs will be used on the south polar journey. He has sent to Siberia for dogs and ponies. In his final march for the Pole, he expects to have sixteen men with him. He will take supplies for three years, and, even if he reaches the Pole in the first season, he expects to spend the summer of 1911-12 in further explorations.

CLIMATOLOGY

EARLY CIVILIZATIONS IN EUROPE AND AMERICA. In his inaugural lecture as Kaiser Wilhelm Professor at Columbia University (published in *Science*, Feb. 26, 1909, and the *Scot. Geog. Mag.*, July, 1909), Professor Albrecht Penck brought out, in an interesting manner, some of the larger facts regarding the early civilizations of Europe and America in relation to climatic controls. European civilization, there is no doubt, had its origin in the Orient. In Mesopotamia and Egypt an early civilization arose under arid and semi-arid conditions, based on irrigation, and this civilization was spread by the early navigators over the whole Mediterranean basin, where it everywhere found congenial conditions. In America the conditions under which early civilization was developed on the Mexican plateau were in many respects similar to those in the Orient. But the Mexican civilization was more feeble, and it could not extend in the same way. The American Mediterranean is much larger than the European, and early navigators did not find here the same landmarks which made it possible for the Phœnicians and the Greeks to sail so far. Furthermore, the shores of the American Mediterranean were not as inviting to settlers as those of Greece, Italy, Spain or northern Africa, for the former are covered widely with forests, dense and penetrable only with great difficulty. In fact, a belt of these virgin forests hindered the Mexicans from extending their civilization down to the Gulf of Mexico. The Gulf has, therefore, never played a rôle like that of the Mediterranean. The forests of peninsular North America were far out of reach of the original American civilization, which could not spread over the shores of the American Mediterranean, nor across the arid regions and deserts north of Mexico. Thus the Indian inhabitants remained here in the state of hunters, and did not clear the woodland. It was only after European settlers came, who had learned in Europe to overcome the resistance of forests to agriculture, that the natural riches of the forested area of North America were developed. R. DEC. W.

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OBITUARY

COL. GEORGE EARL CHURCH. This well-known civil engineer and geographer died in London, on Jan. 5, aged 74 years. He possessed probably a wider and more complete knowledge of the history, the geography, and the resources of tropical South America than any other authority. For many years he travelled extensively in the heart of the continent, and the information thus acquired was supplemented by a life-time of study of the experiences of other travellers, both past and present. By birth a citizen of the United States, Col. Church resided during the later years of his life in London. He was president of the Geographical Section of the British Association in 1898 and was long active as a member of the Council of the Royal Geographical Society and as a contributor to its *Journal*.

PERSONAL

Professor William M. Davis lectured before the Geological department of Colgate University on Dec. 20. His subject was "The Italian Riviera Levante."

Professor R. E. Dodge of Teachers College, Columbia University, lectured at the University of Wisconsin on Wednesday, Dec. 1, on "The New Movement in Secondary School Geography."

Dr. John M. Clarke, State Geologist of New York, has received the honorary degree of Doctor of Science from Colgate University.

At the annual banquet of the Geographic Society of Chicago on Jan. 26, the Helen Culver gold medal of the Society was presented to Prof. Thomas C. Chamberlin and also to Commander Robert E. Peary, U. S. N.

Mr. Shackleton, the Antarctic explorer, has been created a Knight by King Edward VII. Since his return from the Antarctic, he has also received many of the highest honors conferred by geographical societies.

Prof. William H. Holmes on Jan. 1 severed his official connection with the Bureau of American Ethnology and resumed his place as head curator of anthropology in the U. S. National Museum. He also becomes curator of the National Gallery of Art. His preference has always been for museum work.

Mr. F. W. Hodge on Jan. 1 entered upon his duties as chief of the Bureau of American Ethnology. The position, being vacated by Prof. W. H. Holmes, naturally falls to Mr. Hodge on account of his many years of intimate acquaintance with its operations.

Prof. Dr. Penck of Berlin and Prof. Dr. Partsch of Leipzig have been elected corresponding members of the Academy of Sciences in Munich.

Dr. Karl Sapper, Professor of Geography at the University of Tübingen, has been invited to take the chair of Geography in the University of Strassburg as successor to Prof. Dr. Gerland.

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GEOGRAPHICAL LITERATURE AND MAPS

(INCLUDING ACCESSIONS TO THE LIBRARY)

BOOK REVIEWS AND NOTICES

Camp-Fires on Desert and Lava. By William T. Hornaday, Sc.D. xxi and 366 pp., 2 Maps, many photographic Illustrations, 6 colored Plates, and Index. Charles Scribner's Sons, New York, 1908. $3.

All who have read Dr. Hornaday's work entitled "Camp-Fires in the Canadian Rockies" will heartily welcome this new book from his pen. It fully maintains the high standard he established in his earlier work. It successfully combines qualities of superior excellence which, too often, fail to mark writings on geography, botany, zoology and sport. These several topics are all prominent in the book; and though it contains so much solid and important information, the whole is presented in a way to interest and edify all intelligent readers.

The work describes a region in southern Arizona that was very little known and the large Pinacate district in northern Mexico which was practically a *terra incognita*. The whole is a story of desert life and conditions. It was a winter exploration, for it is folly to explore deserts in hot weather; and in November, Dr. Hornaday found southern Arizona fascinating in its boundless space, glorious sunshine and balmy air. The face of nature was clean, and there was utter escape from the dirt and pollution that wear on human life in the great cities.

In Dr. MacDougal, John M. Phillips and Godfrey Sykes, the author had most valuable assistants, and their contributions to this volume add much to its worth. Mr. Sykes made the first map of the Pinacate region, and his first sketch of the map appeared in the *Bulletin* (Vol. 40, p. 708) to illustrate an article by Dr. MacDougal on the geography of the lands described in this book. The photographs are excellent and the colored plates are especially fine. The work is an important contribution to our knowledge of one of the least known parts of North America.

The Rockies of Canada. A Revised and Enlarged Edition of "Camping in the Canadian Rockies." By Walter Dwight Wilcox. Third Edition. ix and 300 pp., Map, over 40 Photogravures and other Illustrations from original photographs by the author, and Index. G. P. Putnam's Sons, New York, 1909. Price, $5.

The Canadian Rockies are growing every year in popularity, and governmental and private enterprise are making them much more accessible as a pleasure ground. The result is that nearly every year supplies something new about them. In the present edition of this work a considerable part of the text has been rewritten and nearly half of the steel plates are new. The illustrations are probably the best that have yet appeared in any work relating to these moun-

tains. They are the result of long effort to secure perfect pictures from the loveliest and grandest places among these snow-capped peaks. This excellent book together with the Canadian governmental and private publications on the neighboring Selkirks afford the literary material needed by the throngs that visit those regions.

The Copper Resources of California. Issued by the California State Mining Bureau under the Direction of Lewis E. Aubury. 366 pp., Maps, Illustrations, Appendix, and Index. W. W. Shannon, Superintendent State Printing, Sacramento, 1908.

This report was first published in 1902. Since then the development of copper mining in California has been very large. The publication has been brought up to date and supplies much information on the development of this industry in the past six years. Practically all the copper prospects and mines are described. The illustrations are good and a number of maps help the text.

What the White Race may learn from the Indian. By George Wharton James. 270 pp. and Illustrations. Forbes & Co., Chicago, 1908. $1.50.

Well illustrated and interesting, this very readable book still cannot claim much space in a specifically geographical publication. It belongs to a kind of literature that might be termed popular ethnography with an inclination to polemics. It also caters to a tendency of great benevolence towards the Indian. The red man and the white man are constantly confronted and contrasted, and in the course of this process the author finds occasion to tell many interesting facts in the shape of descriptions of Indian customs and also to state a number of truths not complimentary to the white man, but none the less true. The author confines his field of operation to the United States and is careful not to generalize too much. It is evident that not everybody will agree with him, and that even those who in the main support his ideas and opinions will dissent from them on various points; but everybody who takes an interest in the question will be glad to read the book. The work is worthy of commendation in a general way and hence creditable to its author both through its text, general make-up and pictures.

A. F. BANDELIER.

The South Americans. By Albert Hale. 361 pp., with numerous Maps and Illustrations. The Bobbs-Merrill Co., Indianapolis, 1907. $2.50.

This work bears the sub-title which is explanatory, "The story of the South American Republics, their characteristics, progress and tendencies; with special reference to their commercial relations with the United States." It is dedicated to Secretary Elihu Root, the "one great statesman of recent years who has understood the Latin temperament . . ." The author repeatedly implies and positively states his lament that there are so few North Americans who have a just appreciation of their South American neighbors or of the mutual profit to be derived from a more intimate acquaintance, the one with the other. Mr. Hale writes as one who knows his subject from long acquaintance with it. He tells us that he has known South America for twenty-five years through intimate association, extended residence and the experiences of travel. The book does not purport to be an exhaustive study of Latin America. It reads now like a travel narrative, now like a statistical record, social, political, educational, economical. Com-

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parisons are frequent, and the ideas thus suggested are elaborated and fully explained.

In the moral sense he finds the Latin American inferior to the "Yankee," which last expression he tells us is a dignified word in both Spanish and Portuguese. In the artistic sense the advantage is with the South American. He has no special word of condemnation for the business methods of the North American save as these methods touch trade relations with the south. Here he finds two great mistakes. "One is the lack of comprehension of what those people require, the other is the unwillingness to persevere in efforts to secure trade." It is clearly the author's intent to make plain that there is wanting a helpful sympathy between north and south.

In the main it is the Atlantic and the Caribbean Sea states which are discussed, and this under the general chapter analysis of Geography, History, Government, the People and their present conditions.

The concluding chapters deal with "The South American Situation," which is an attempt at a summary, and with the "Monroe Doctrine," which the author refers to, with much point, as the political romance of the nineteenth century, for who can give it clear and accurate definition? To the end that honesty and fair dealing may be upheld, it is urged that the position of the United States should be clearly stated. E. L. STEVENSON.

Wanderings in South America. With Original Instructions for the perfect preservation of Birds, etc. By Charles Waterton. Including a Memoir of the Author by Norman Moore and an Introduction by Charles Livingston Bull. xxvi and 338 pp., Illustrations and Index. Sturgis & Walton Company, New York, 1909. $2.50.

This reprint of Waterton's book deserves attention. His travels in British Guiana, the north-west of the United States and the Antilles occupied most of his time between 1812 and 1824. His excessive modesty is shown in his preface to the first edition, where he says that his book "has little merit and must make its way through the world as well as it can." The book is, in fact, a classic. Its author was a born naturalist and wrote of nature with love and enthusiasm. The practical instructions as to the method of collecting and preserving specimens, which Waterton gave, have been of great benefit to other wanderers in tropical regions. He tells nothing of personal difficulties and discomforts, gives no information of the guide book kind, but all his pages are filled with his observations of birds and beasts and their environment in the tropical forests.

Zwei Jahre unter den Indianern. Reisen in Nordwest-Brasilien, 1903-1905, von Dr. Theodor Koch-Grünberg. Erster Band. iv and 359 pp., Map from original surveys of the author, 227 Illustrations and 12 Plates. Ernst Wasmuth, Berlin, 1909.

Dr. Koch-Grünberg was the first explorer to visit some of the extreme upper tributaries of the Rio Negro. Accomplished in most phases of geographical work, he has described this unknown region and made the first map of its rivers and of the distribution of its Indian tribes. The publication of the results of his scientific work and of his superb plates illustrating the various tribes has preceded the appearance of the present volume and attention has been called to them in the *Bulletin* (Vol. 38, p. 376; Vol. 39, p. 296; Vol. 40, p. 227; and Vol. 41, p. 706). Altogether, he has published 14 monographs and papers on his fruitful

two years' work. A list of them appears in the preface to this handsome volume, which tells the history of his explorations and describes its results for the general reader. The book is handsomely produced and illustrated, and is one of the best contributions of the past year to geographical literature.

The Frontiers of Baluchistan. Travels on the Borders of Persia and Afghanistan. By G. P. Tate. With an Introduction by Col. Sir A. Henry McMahon. xvi and 261 pp., 2 Maps, 37 Illustrations, and Index. Witherby & Co., London, 1909. 12s. 6d.

Few persons are more familiar with northern Baluchistan and the adjacent portions of Afghanistan and Persia than Mr. Tate. Much of his life has been devoted to surveys for the Indian government on the northwest frontier of India, and he has made three protracted journeys from the Indus to Persia and back. During his last journey, as a member of Sir Henry MacMahon's Boundary Commission from 1902 to 1904, he spent more than two years in the unique basin of Seistan, near the corner where Persia borders upon Afghanistan and Baluchistan. In view of Mr. Tate's familiarity with the country, one takes up his book with lively expectations of finding a solution of some of the great problems which centre around Seistan. In scarcely a single case are such expectations gratified. The book is arranged for the most part according to the strict sequence of the author's journeys, with the natural result that a given subject is treated briefly in various places, and the reader fails to get the full benefit of what is actually stated quite fully, and the difficulty is increased by the sketchy and parsimonious character of the two maps. To take a subject of minor importance as an illustration, the book contains a large amount of really valuable and interesting information as to camels and their ways; but diseases are treated briefly in two or three different places, capacity for loads in another, and relation to moisture, ability to endure thirst, methods of native surgery by means of a heated sickle, ferocity during the mating season, the character of albinos, etc., in still other places.

One of the best features of the book is its descriptions of desert scenery and colors, somewhat minute and detailed, to be sure, but giving a vivid idea of the beauty of the desert at certain times. Another good point is the vivid picture of the difficulties of life in the desert, the bitter cold during the windy days of winter, and the burning heat and thirst of summer. The horrors of Seistan, its blighting summer winds, its water-logged condition in spring, its mad wolves, one of which bit 78 camels in one night, and its poor oppressed inhabitants,—all these are treated with more or less fullness. A good deal of space is given to the Wind of 120 Days, which blows with extraordinary violence and steadiness all summer. Its influence upon architecture, vegetation and insect life are well portrayed. The same may be said of certain native habits as to trade, land tenure, and official methods.

Mr. Tate carefully refrains from theorizing in most cases. In regard to the terraces surrounding the Lake of Seistan, however, he departs from this rule and briefly sets forth the theory that they are due to subsidence of the bottom of the lake. Such a theory goes directly counter to the conclusions of Gilbert and Russell, and many others, as to similar phenomena in lakes Bonneville and Lahontan, where the old terraces appear to be lake strands due to changes of climate. Tate, however, does not even mention this theory, and leaves the reader to conclude that the subsidence theory is the only possible explanation.

To most readers the subjects of greatest interest in Seistan are the truly wonderful number of ruins and the present political situation. The ruins are mentioned frequently by Mr. Tate, but are nowhere described in such a way as to give any adequate idea of how they look, by whom they were occupied, and especially why they were abandoned and the land left desolate. To-day the population is estimated at 160,000 people, before the days of Tamerlane at 250,000, and previous to that it must have been much greater. It would be hard to find a subject of greater interest than the cause of this change, but our author scarcely touches the matter.

The reason for the long sojourn of the British Boundary Commission in Seistan was that the Helmand River, like all other streams, builds up its flood plain in the immediate vicinity of the river, and thereby causes its own course to shift to one side or the other. Inasmuch as Seistan is the only place for hundreds of miles where water is available, it is peculiarly valuable to both Afghans and Persians. The river was supposed to be the boundary between the two nations, and when it changed its course, there naturally arose a bitter dispute. If Mr. Tate could have explained the variations in the river's course and told us how they have influenced the people of Seistan directly and the political relations of Persia and Afghanistan, and of England and Russia indirectly, he could have written a book of great general interest and of high geographic value. In fairness to him a word of explanation should be added. For some reason, implied but not stated, he has not felt himself free to enter into a discussion of many of the most interesting problems connected with his work. He refers again and again to the vast amount of data collected by the Commission as to all manner of subjects, but fails to satisfy the thirst for information that he thus arouses. Presumably, the data are all embodied in official reports. Apparently, Mr. Tate knows a great deal which the world would also like to know, but which he has not deemed it best to tell. ELLSWORTH HUNTINGTON.

La Patria. Geografia dell' Italia. Opera compilata dal Prof. Gustavo Strafforello. Provincia di Torino. Seconda edizione interamente riveduta e ampliata a cura del Cav. Giuseppe Isidoro Arneudo. iv and 736 pp., Maps of the Province and City of Turin, 204 Illustrations and Index. Unione Tipografico-Editrice Torinese, Turin, 1907.

This large work is a detailed account of Turin Province, dealing with its history, geography, products, industries, commerce, educational work, arts, monuments, public edifices, benevolent institutions, etc. The theatres, libraries, prominent engineering works and other phases of the Province come in for description and copious illustration. The many pictures from photographs are good, though not produced in a superior manner. Few books about a small part of the world are packed with more information.

Tevere. Nuova Edizione riordinata e ampliata con Atlante. Memoria 26 *bis* della Carta Idrografica d'Italia. xii and 486 pp. Ministero di Agricultura, Industria e Commercio, Rome, 1908. L. 6.

A thorough revision and enlargement of the earlier Memoir on the Tiber River published in 1898. It is accompanied by an atlas showing all phases of the river and its basin. This is the latest of a series of exhaustive Memoirs on the hydrography of Italy which the Government began to publish in 1888. The

series now numbers 36 volumes, and it is of the first importance in the study of all economic questions in which the water resources of the kingdom are involved.

Anmerkungen über Levkas. v and 61 pp., and Illustrations. Heinr. Mercy Sohn, Prague, 1903.

A folio, finely produced and containing several superb colored plates. It describes the little island and town of Levkas, among the Ionian Islands, and is a bit of excellent geographical writing about a small land area that has recently come into considerable notice. This is the island which Prof. Wilhelm Dörpfeld and some other archæologists maintain is identical with the Homeric island of Ithaca, the home of Ulysses. There are others who hold to the faith that the ancient Ithaca was the island that is now known by that name. The literary warfare over this question has resulted in a number of books, with the result that Levkas has become one of the best described, mapped and pictured among the small Greek islands. The unnamed author of the present work does not share the belief of Prof. Dörpfeld, but his book is the most sumptuous volume that has been given to the island. He has left scarcely any thing untouched in the lines of descriptive and human geography, and his pictures of the coasts and of bits of the interior are works of art. He spells the name "Levkas," which is the official, modern Greek spelling, though we as often see it "Leucas."

La France et ses Colonies au début du XXe Siècle. M. Fallex and A. Mairey. vi and 660 pp., Maps, Illustrations, and Index of Place Names. Librairie Ch. Delagrave, Paris. Price, 5 frs.

This is one of the superior geographies recently issued by Delagrave which have already been noticed in the *Bulletin*. It is a fine example of descriptive and synthetic geographical treatment. A good feature is the summary of the contents of each chapter at its opening. The numerous photographic reproductions, diagrams, and maps are excellent.

Feinnivellement des Rheins von Mainz bis zur Niederländischen Grenze. xvi and 177 pp., and 1 Table. Bureau für die Hauptnivellements und Wasserstandsbeobachtungen im Ministerium der öffentlichen Arbeiten. P. Stankiewicz's Buchdruckerei, Berlin, 1908.

This work records the levelling operations on both banks of the Rhine between Mainz, the practical head of navigation for steamboats, as far north as the Netherlands boundary. Many hundreds of exact elevations above the sea were secured along both banks of the river. The methods of the work are described in the introduction. Between 1892 and the present time the German Ministry of Public Works has published over thirty volumes giving the results of similar observations along the banks of the more important rivers in Germany.

The Cadastral Survey of Egypt, 1892–1907. By Captain H. G. Lyons, Director-General. viii and 421 pp., Maps, Plans, Illustrations, 5 Appendices, and Index. National Printing Department, Cairo, 1908. Price, 400 milliemes.

The cadastral survey of Egypt, begun in 1892 as a survey of State lands, developed into a revenue survey in 1896, and became soon afterwards a cadastral survey carried out with technical accuracy and comparable with similar surveys in Europe. The whole of the cultivable lands of Egypt, except the distant oases,

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were surveyed, and land registers, recording the area, and ownership of each property, were prepared. One-third of the country was mapped on the scale of 1:4,000, two-thirds, including all the more fertile districts, on the scale of 1:2,500 and nearly all these maps have now been published. The cadastral survey has been completed, and the present report records in considerable detail the progress and methods of the work with statistical information that may be instructive to surveyors, both in Egypt and elsewhere. The maps, diagrams, and other illustrations are numerous.

Il Ruwenzori. Parte Scientifica. Risultati delle Osservazioni e Studi compiuti sul Materiale Raccolto dalla Spedizione. Two Vols. Vol. I. Zoologia. Prof. L. Camerano and others; Botanica. Dott. E. Chiovenda e Cortesi and others. vii and 603 pp., and 74 pp. of Illustrations; Vol. II. Geologia. Prof. A. Roccati; Petrografia e Mineralogia. Prof. A. Roccati, Prof. Luigi Colomba and Prof. G. Piolti. xix and 286 pp., Geognostic Map of Uganda, and 40 pages of Illustrations. Ulrico Hoepli, Milan, 1909. Price, 50 Lire.

Very few societies could afford the sum for the printing of scientific results that the Duke of the Abruzzi has expended on these two sumptuous volumes. The collections made by his expedition to the Ruwenzori Mts. were placed in the hands of Italian specialists. Thirteen of them worked out and describe, in Vol. 1, the zoological results. The botanical work was distributed among eight scholars. Vol. 2 gives 164 pp. to geology and the text concludes with the discussion of the petrographic and mineralogical results. The first volume adds considerably to our knowledge of the natural history and botany of the western part of British East Africa and his second is one of the most important contributions yet made to the study of the geology of Equatorial Africa. The numerous plates have rarely been equalled in African photography.

Die Weltumsegelungsfahrten des Kapitäns James Cook. Ein Auszug aus seinen Tagebüchern. Bearbeitet und übersetzt von Dr. Edwin Hennig. 554 pp., 1 Map, and 8 Illustrations. Gutenberg-Verlag, Hamburg, 1908. Price, M. 6.

An excellent selection of material from Capt. Cook's own story of his famous voyages and discoveries. This is Vol. 1 of the "Bibliothek denkwürdiger Reisen" which is being issued under the editorship of Dr. Ernst Schultze. Dr. Hennig has made a good translation and his selections give an idea of the great explorer's contributions to geographical knowledge. The readable character of the English narrative is well preserved.

Kulturpflanzen der Weltwirtschaft. Unter Mitwirkung erster Fachleute herausgegeben von Otto Warburg und J. E. van Someren Brand. xiv and 411 pp., 653 Photographic Reproductions and 12 Illustrations in Colors. R. Voigtländers Verlag, Leipzig. Price, 20 Marks.

One of the best books that has been given to the exposition of agricultural industries. The work describes the cultivation and preparation for market of rice, wheat, maize, sugar, wine, coffee, tea, cacao, tobacco and cotton. In the chapter on tobacco, for example, the history of the plant and of its distribution is given and the phases of production, and manufacture in various countries are

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depicted in text and illustrations. The chapter gives a comprehensive view of the importance of tobacco in all countries where it is produced, manufactured and consumed. The text is intended for all intelligent readers and its interest is emphasized by the extraordinary number of photographic reproductions and of pictures in colors, one or more of which appear on every page. Mr. Warburg, one of the editors of the work, is well known as an authority on tropical agriculture and the editor of *Der Tropenpflanzer,* Berlin.

Text-Book of Petrology. By F. H. Hatch. Fifth Edition. xvi and 404 pp. and Illustrations. Swan, Sonnenschein & Co., London, 1909. $1.90.

The fifth edition of this text-book on the petrology of the igneous rocks has been so much enlarged that it contains, approximately, three times as much material as the first edition which appeared eighteen years ago. With its more numerous illustrations, more complete lists of chemical analyses, and fuller references to the literature of petrology, the present edition deserves to be classed among the best of the smaller text-books on the subject.

The author divides the book into four parts, the first of which deals with "the physical characters of the igneous rocks." The modes of occurrence of igneous rocks are described briefly under such paragraph headings as Stocks, Dykes, Laccoliths, Necks, etc.; columnar and other types of joint structure, flow structure, and other features of "External structure" are treated in a short chapter; while texture or micro-structure, and composition, both chemical and mineralogical, receive a more extented treatment in the two following chapters.

Part II deals with "the constitutent minerals of the igneous rocks," discussing several bases of classification and presenting in the first chapter in tabular form, a classification of the more important minerals. In the second chapter certain optical properties of minerals as seen in thin sections are discussed; chapter three is devoted to the detailed description of the rock-forming minerals.

Part III considers "the classification of igneous rocks" under the three chapter headings: Plutonic Rocks, Hypabyssal Rocks, and Volcanic Rocks. Further classification is based on the silica content, with the alkali and calc-alkali contents as a basis for still further subdivision. In Part IV the "distribution of the igneous rocks as illustrated by the British Isles" is treated in three chapters, while a table for the determination of rock-making minerals in thin sections, by R. H. Rastall and J. Romanes, is given in an appendix. D. W. JOHNSON.

CURRENT GEOGRAPHICAL PAPERS

NORTH AMERICA

NICKLES, JOHN M. Bibliography of North American Geology for 1908. With subject index. U. S. Geol. Surv., *Bull.* 409, 148 pp., 1909. [Includes papers in a large number of serials.]

United States

ABENDANON, DR. J. H. L'enseignement des indigènes de l'Alaska, des Indiens

aux États-Unis et des indigénes aux îles Philippines. *L'enseignement aux indigènes,* 9me Série, Tome 1, pp. 243-285. Institut Col. Intern., Brussels, 1909.

ASHLEY, GEORGE H. Stratigraphy and Coal Beds of the Indiana Coal Field. Investigations of Coal Fields, U. S. Geol. Surv., *Bull.* 381-A, pp. 5-14, 1909.

ASHLEY, GEORGE HALL. Coal Deposits of Indiana. (Supplementary to *Report* of 1898.) Maps, Profiles. 33d *Ann. Rep.* Dep't. Geol. and Min. Res. of Ind., pp 17-273, Indianapolis, 1909.

BARRY, JOHN G., AND MELSTED, V. J. The Geology of Northeastern North Dakota with special reference to Cement Materials. Map., Ills. Fifth Biennial *Rep.* N. D. Geol. Surv., pp. 116-225, Bismarck, 1908.

BLATCHLEY, W. S. The Petroleum Industry in Indiana in 1908. *Ann. Rep.* Dep't. Geol. and Min. Resources of Indiana, pp. 361-82, 1909.

BRIGHAM, PROF. A. P. Capacity of the United States for Population. Reprinted from the *Pop. Sci. Mo.,* pp. 209-20, Sept., 1909.

BUTLER, B. S. The Production of Copper in 1908. 46 pp. U. S. Geol. Surv., Washington, 1909.

CALVERT, W. R. Geology of the Lewistown Coal Field, Mont. 2 maps, 3 plates, 1 fig. U. S. Geol. Surv. *Bull.* 390, 83 pp., 1909. [Gives results of survey in 1907.]

CAPPS, JR., STEPHEN R. Pleistocene Geology of the Leadville Quadrangle, Colorado. 3 maps, photos, sections and diagrams. *Bull.* 386, 99 pp. U. S. Geol. Sur., 1909. [Especially given to a study of glaciation.]

CLEVELAND, TREADWELL. The Status of Forestry in the U. S. Dep't. of Agric., Forest ser., *Circular* 167, pp. 39, 1909.

COVERT, C. C., AND C. E. ELLSWORTH. Water-Supply Investigations in the Yukon-Tanana Region, Alaska, 1907-1908. Fairbanks, Circle and Rampart Districts. 104 pp., Maps, Ills. *Water Supply Paper* 228, U. S. Geol. Sur., 1909.

DOUGLAS, JAMES. The Influence of the Railroads of the U. S. and Canada on the Mineral Industry. Inst. of Mining and Metallurgy, 19th Session. 52 pp., 1909-10.

HOWE, ERNEST. Landslides in the San Juan Mountains, Colorado: Their Causes and Classification. Maps, Ills. Prof. Pap. 67, pp. 58, U. S. Geol. Sur., 1909.

KOEBERLIN, F. R. The Brewster Iron-Bearing District of New York. Maps and Bibliog. *Economic Geology,* Vol. 4, No. 8, pp. 713-754, 1909.

LEONARD, A. G. Geology of Southwestern North Dakota, with special reference to Coal. Map, Ills. Fifth Biennial *Rep.* N. D. Geol. Sur., pp. 29-114, Bismarck, 1908.

MATSON, G. C. Water Resources of the Blue Grass Region, Ken. Quality of the Waters, by C. Palmer. *Water-Supply Pap.* 233, 223 pp., U. S. Geol. Sur., 1909.

MEEKER, F. N., AND W. J. LATIMER. Soil Survey of the Parkersburg Area, West Virginia. 36 pp. Maps. U. S. Dep't. of Agric., Sept., 1909.

PEPPERBERG, LEON J. The Milk River Coal Field, Montana. pp. 78-103. Map. U. S. Geol. Sur., *Bull.* 381-A, 1909.

QUACKENBUSH, L. S. Notes on Alaskan Mammoth Expeditions of 1907 and 1908. Map and Ills. *Bull.* Amer. Museum of Nat. Hist., Vol. 26, pp. 87-130, 1909.

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RICHARDS, R. W. The Central Part of the Bull Mountain Coal Field, Montana. pp. 56-77. Maps. U. S. Geol. Sur., *Bull.* 381-A, 1909.

SINGEWALD, JR., JOSEPH T. The Iron Ores of Maryland. Map. *Econ. Geol.*, Vol. 4, No. 6, pp. 509-43, Lancaster, Pa., 1909.

SMITH, C. D. The Fort Peck Indian Reservation Lignite Field, Montana. pp. 36-55. Map. *Investigations* of Coal Fields, U. S. Geol. Sur., *Bull.* 381-A, 1909.

SMITH, C. D. The Wasbhurn Lignite Field, North Dakota. Maps. U. S. Geol. Sur., *Bull.* 381-A, pp. 15-25, 1909; The Fort Berthold Indian Reservation Lignite Field, North Dakota. pp. 26-35.

TARR, RALPH S., AND BERT S. BUTLER. The Yakutat Bay Region, Alaska: Physiography and Glacial Geology by R. S. Tarr; Areal Geology by R. S. Tarr and Bert S. Butler. U. S. Geol. Sur., *Profess. Pap.* 64, 183 pp., 1909.

WEGEMANN, CARROLL H. Notes on the Coals of the Custer National Forest, Montana. Map. U. S. Geol. Sur., *Bull.* 381-A, pp. 104-110, 1909.

WHITE, L. L. Restricting the Free Use of Timber in our National Forests. *Forestry Quarterly*, Vol. 7, No. 3, pp. 238-242, 1909.

WORTHEN, E. L., AND H. L. BELDEN. Soil Survey of East Carroll and West Carroll Parishes, Louisiana. 28 pp. Map. U. S. Dep't. of Agric., Sept., 1909.

—— Average Wood Production in the United States. *Forestry Quarterly*, No. 4, Vol. 7, pp. 377-384, 1909.

—— Report of the Chief of the Weather Bureau. 1907-1908. xxxiii and 397 pp. U. S. Weather Bureau, 1909.

Canada

DAWSON, W. BELL. Tide Tables for the Eastern Coasts of Canada for 1910. 55 pp. Tidal and Current Survey, Ottawa, 1909.

—— Eighth Report of the Geographic Board of Canada containing all Decisions to June 30, 1909. *Sessional Paper* No. 21a. 123 pp. Ottawa, 1909.

Mexico

INKEY, B. DE. Des volcans du Méxique. Ills. *Abrégé du Bull.* Soc. hongroise de géog. Supplement to Vol. 36, *Földrajzi Közlemények*, parts 8-10, pp. 151-61, Budapest, 1908.

ROTHKUGEL, MAX. Brief Notes on Mexican Forests. *Forestry Quarterly*, Vol. 7, No. 3, pp. 277-279, 1909.

—— List of Works in the New York Public Library Relating to Mexico. *Bull.* of the N. Y. Pub. Libr., Vol. 13, Nos. 10, 11, 12, New York, 1909.

SOUTH AMERICA

Argentina

KLUGE, HERMAN. Argentina and its Chaco. *Forestry Quarterly*. Vol. 7, No. 4, pp. 410-414, 1909.

Bolivia

—— Bogota. Ills. *Bull. Amer. Repubs.* Vol. 29, No. 10, pp. 751-8, 1909.

Brazil

BELFORT MATTOS, J. N. Dados Climatologicos do anno de 1905. Map. Secretaria da Agric., Commerc., e Obras Pub., do S. Paulo, *Bol.* 7, Serie 2, 1909.

SPERBER, O. Gummi und Gummigewinnung im oberen Amazonasgebiete. *Export*, Vol. 31, No. 51, pp. 702-703, 1909.

Chile

—— Anuario del Servicio Meteorolójico de la Direccion del Territorio Marítimo. 406 pp. Diagrams. [Gives tabulated meteorological data collected at 10 stations on the Chilean coast and islands.] Vol. 9 for 1907, Valparaiso, 1908.

Dutch Guiana

MIDDELBERG, E. Geologische en Technische Aanteekeningen over de Goudindustrie in Suriname. Map, Profiles, Ills. [The gold industry of the Colony in its geological and technical aspects.] Published by the Colonial Government, 1908.

MIDDELBERG, E. Geologische en technische Aanteekeningen over de Goudindustrie in Suriname. 132 pp., Map, Ills. J. H. de Bussy, 1908.

Peru

CISNEROS, CÉSAR. Censo de la provincia de Yungay. *Boletin* de la Soc. Geog. de Lima, Vol. 21, Trim. 4, pp. 470-480, 1909.

MARSTERS, V. F. Informe sobre la Costa sur del Perú. Map, Ills. *Bol.* del Cuerpo de Ingenieros de Minas del Perú, No. 70, 112 pp., Lima, 1909.

VILLALTA, JUAN S. Expedición al Tambopata. *Boletin* de la Sociedad Geog. de Lima, Vol. 21, Trim. 4, pp. 440-458, 1907.

AFRICA

East Africa

HIRTH, PROF. FRIEDRICH. Early Chinese Notices of East African territories. *Journal* of the Amer. Oriental Soc., Vol. 30, Part 1, pp. 46-57, 1909.

ROSSETTI, CARLO. Organisation de la lutte contre l'alcool dans la colonie Érythrée. *Compte Rendu* de la Session tenue à La Haye. pp. 357-389. Bib. Coloniale Internationale, Brussels, 1909.

ROSSETTI, CARLO. Organisation de la lutte contre l'alcool et l'opium au Soudan Anglo-Egyptien. *Compte Rendu,* Session de La Haye. pp. 391-432. Institut Col. Intern., Brussels, 1909.

North Africa

ARTBAUER, OTTO C. Die Berber in den Bergen des Rif. Ills. *Deutsche Rundsch. f. Geog. u. Stat.,* Vol. 32, No. 2, pp. 55-69, Vienna, 1909.

PASSARGE, SIEGFRIED. Verwitterung und Abtragung in den Steppen und Wüsten Algeriens. Ills. *Geog. Zeitsch.,* Vol. 15, No. 9, pp. 493-516, 1909.

—— Salzindustrie in Manga [Sahara]. Ills. *Globus,* Vol. 96, No. 18, pp. 281-3, 1909.

South Africa

BECK, J. H. MEIRING. The Wine Industry in South Africa. *Agricul. Jour.* of the Cape of Good Hope, Vol. 35, No. 5, pp. 593-598, 1909.

BRYANT, THE REV. ALFRED T. Zulu Medicine and Medicine Men. *Annals* of the Natal Gov. Museum, Vol. 2, Part 1, pp. 1-104, Adlard & Son, London, 1909.

West Africa

BENCKE, ALBERT. An der Wasserscheide zwischen Kongo und Zambesi. Map. *Deutsche Rundsch. f. Geog. u. Stat.,* Vol. 32, No. 2, pp. 69-75, Vienna, 1909.

BOHNY, DR. PAUL. Eine Fahrt nach den kanarischen Inseln. Ills. *Jahrbuch* des Schweizer Alpenclub, 1908-1909. pp. 131-160. Bern.

JANSSEN, CAMILLE. Régime des boissons alcooliques dans la colonie du Congo Belge. *Compte Rendu* de la Sessions tenue à La Haye en 1909. pp. 344-356. Institut Col. Intern., Brussels, 1909.

XUM

KÜRCHHOFF, D. Alte und neue Handelsstrassen und Handelsmittelpunkte in West-Afrika. *Geog. Zeitsch.*, Vol. 15, No. 9, pp. 520-30, 1909.

MULLER, RUDOLF. Regenverteilung, Pflanzendecke und Besiedlung Ober-Guineas und des westlichen Sudan. Map, diagrams. *Geog. Zeitsch.*, Vol. 15, No. 11, pp. 620-41, Leipzig, 1909.

WAUTERS, A.-J., La Frontière orientale de notre Colonie. Map. *Le Mouve. Géog.*, Vol. 26, No. 45, Cols. 535-8, Brussels, 1909. [Belgian Congo.]

—— La Flora du Congo. *Le Mouve. Géog.*, Vol. 26, No. 40, Cols. 469-72, 1909.

—— Les Pêcheries et les poissons du Congo. *Le Mouve. Géog.*, Vol. 26, No. 45, Cols. 538-41, Brussels, 1909.

—— La Navigabilité de la Gambie en amont de la frontière anglaise. Map. *L'Afrique Franç.*, Vol. 19, No. 10, pp. 339-42, Paris, 1909.

ASIA

China

HIRTH, PROF. FRIEDRICH. The Mystery of Fu-lin. *Journal* of the Amer. Oriental Soc., Vol. 30, Part 1, pp. 1-45, 1909.

LANTENOIS, H. Résultats de la Mission géologique et minière du Yunnan méridional (Sept., 1903-Jan., 1904). Maps and Profiles. 209 pp. Extract from *Annales des Mines*, March and April, 1907. H. Dunod & E. Pinat, Paris, 1907.

NOVICKI, V. F. *Putieshetsviia po Mongolii v* 1906 [Travels in Mongolia]. *Izviestiia* of the Imp. Russian Geog. Soc., Vol. 45, No. 4-6, pp. 253-279, 1909.

Dutch East Indies

MOSZKOWSKI, MAX. Mittelalterlicher Feudalismus in Inner-Sumatra. Ills. *Globus*, Vol. 96, No. 17, pp. 261-4, 1909.

SNOUCK-HURGRONJE, DR. L'importance de l'Islamisme pour la colonisation européenne aux Indes orientales néerlandaises. *Compte Rendu* de la Session tenue à La Haye. Bib. Col. Internationale, Brussels, pp. 459-69, 1909.

India

HOLLAND, SIR THOMAS H., AND W. A. K. CHRISTIE. Origin of the Salt Deposits of Rajputana. Map and 2 Plates. *Records* Geol. Surv. of India, Vol. 38, Part 2, pp. 154-86, Calcutta, 1909.

WEHRLI, DR. HANS J. Über Dürren in Britisch-Indien. Ein Beitrag zur Wirtschaftsgeographie Indiens. 2 Maps and Diagrams. *Jahresbericht* der Geog-Eth. Gesell. in Zürich, 1908-9, pp. 221-56, 1909.

Indo-China

LAMOTHE, RENÉ DE. Note sur la géologie du Cambodge et du Bas-Laos. Map. *Mémoires* de la Soc. Géol. de France, 4th Ser., Vol. 1, *Mem.* 5, pp. 57-61, Paris, 1907.

LANTENOIS, H. Note sur la Géologie de l'Indo-Chine. Map. *Mémoires* de la Soc. Géol. de France, 4th Ser., Vol. 1, *Mem.* 4, pp. 1-56, Paris, 1907.

MANSUY, H. Contribution à la Carte géologique de l'Indo-Chine. Paléontologie. 73 pp., 18 plates. Service des Mines de l'Indo-Chine, Hanoi, Tonkin, 1908.

MANSUY, H. Stations préhistoriques de Somron-Seng et de Longprao (Cambodge). [15 plates of prehistoric finds.] 29 pp. *Report* to the Director of Agriculture, etc., Hanoi, Tonkin, 1902.

XUM

ZEIL, CAPTAIN G. Contribution à l'étude géologique du Haut-Tonkin. Map, geological sections and profiles. *Mémoires* de la Soc. Géol. de France, 4th Ser., Vol. 1, *Mem.* 3, pp. 5-19, Paris, 1907.

Persia, Corea, Japan, Arabia

HOUTUM-SCHINDLER, GEN. A. Klimatafeln aus Persien. *Pet. Mitt.*, Vol. 55, No. 10, pp. 269-70, 1909.

KOTO, B. Journeys through Korea. Maps and Ills. *Journal* of College of Sci., I. Univ. of Tokyo, Vol. 26, 207 pp., 1909.

NEZDUROV, D. F. Excursion into the Ararat Region. [In Russian.] Ills. *Izviestiia* of the Imp. Russian Geog. Soc., Vol. 45, No. 4-6, pp. 281-290, 1909.

VISSER, DR. M. W. DE. The Fox and the Badger in Japanese Folklore. *Transactions* Asiatic Soc. of Japan, Vol. 36, Part 3, 169 pp., 1908.

Philippines

ALGUE, REV. JOSÉ. Mirador Observatory, Baguio, Benguet. Ills. 11 pp. Weath. Bur., Manilla Central Observatory, 1909. [A new meteorological-geodynamic station of the Philippines Weather Bureau.]

MASO, REV. M. S. Earthquakes felt in the Philippines in March and April, 1909. *Bull.* Weath. Bur. for March, pp. 93-5, and April, pp. 127-9, Manilla, 1909. [Nine observed in March and 12 in April with intensities of 2, 3, 4, 6 and 7 according to the De Rossi-Forel scale.]

PIEHLER, A. BR. Die Ajitas (Aëtas) der Philippinen. Ills. *Globus*, Vol. 96, No. 13, pp. 197-201, 1909.

Russian Central Asia

BERG, L. *Aralskoye Morie.* [Scientific Results of the Aral Expedition]. Maps, Tables, and Ills. *Izviestiia* Turkestan Branch of Imp. R. Geog. Soc., Vol. 5, No. 9, St. Petersburg, 1908.

AUSTRALASIA AND OCEANIA

FINLAYSON, A. M. Problems in the Geology of the Hauraki Gold Fields, New Zealand. *Econ. Geol.*, Vol. 4, No. 7, pp. 632-45, 1909.

KENSINGTON, WILLIAM C. *Annual Report* of the Department of Lands, New Zealand, for 1908-9. Maps and Ills. 42 pp. Wellington, 1909.

STEPHENS, T. Notes on the Geology of the Northwest Coast of Tasmania from the river Tamar to Circular Head. Map, and Ills. *Proc.* Linnean Soc. of New South Wales, Vol. 32, Part 4, pp. 752-67, Sydney, 1909.

—— Fisheries of New South Wales. Report of Board for 1908. 67 pp., 1909.

EUROPE

MORAND, MARCEL. De l'importance de l'Islamisme pour la colonisation européenne. *Compte Rendu* de la Session tenue à La Haye. pp. 433-457. Bib. Col. Intern., Brussels, 1909.

SCHLUTER, DR. O., AND OTHERS. Die Fortschritte der Länderkunde von Europa. *Geographisches Jahrbuch*, Vol. 32, Erste Hälfte. pp. 69-242. Justus Perthes, Gotha, 1909. [All the countries of Europe are included excepting Norway and Russia.]

Austria-Hungary

HOLLE, A. Einteilung und Orometrie des Tatragebirges nebst einem Beitrag zur Wald-und Knieholzgrenze. 135 pp., Map and 6 Tables. *Abhandlungen* k. k. Geog. Gesellschaft in Wien, No. 2, Vol. 8, 1909.

France

BUFFAULT, PIERRE. De l'origine prétendue marine des lacs du littoral de Gascogne. *Bull.* de la Soc. de Géog. Commerciale de Bordeaux, Vol. 35, No. 12, pp. 285, 289, 1909.

Italy

NUSSBAUM, DR. F. Eine geographisch Studienreise im nördlichen Apennin zwischen Ancona und Florenz. pp. 161-173. Map and Diagrams. *Jahrbuch des Schweizer Alpenclub*, 1908-09.

—— Notizie complementari alle Statistiche giudiziarie penali degli anni 1896-1900. ccxii and 663 pages. Direzione Gen. della Statistica, Rome, 1909.

—— Statistica giudiziaria penale per gli anni 1905 e 1906. cxcii and 292 pp. Direzione Gener. della Statistica, Rome, 1909.

Portugal

ACKERMANN, EUGENE. L'île de Madère considérée au point de vue de ses richesses minérales. *Boletin* da Soc. de Geog. de Lisboa, Nos. 10 and 11, 1909.

Russia

BELOBORODOV, V. The Projected Obi-Archangel Railroad. [In Russian.] *Izviestiia* of the Archangel Society for the Exploration of Northern Russia, No. 7, pp. 27-35, 1909.

BUSH, N. A. Botanical-geographical Explorations in the Kuban Region in 1908. [In Russian.] Ills. *Izviestiia* Imp. Russian Geog. Soc., Vol. XLV, Nos. 4-6, pp. 241-251, 1909.

KRAH, CARL. Die Insel Runö und ihre Bewohner. Ills. *Globus*, Vol. 96, No. 12, pp. 181-6, 1909.

MEKK, ALEXANDER V. Women Alpinists. [In Russian.] *Zapiski* of the Crimean-Caucasian Alpine Club, No. 2, pp. 77-97, Odessa, 1909.

PERESHNEV, M. The Obi-Archangel Railroad. [In Russian.] *Izviestiia* Archangel Soc. for Explor. of north Russia, No. 12, pp. 62-70, 1909.

PINEGIN, N. Aino Islands. [In Russian.] *Izviestiia* Archangel Soc. for Explor. of north Russia, No. 13, pp. 62-74, 1909.

VOLTMAN, V. N. The Projected Eastern Ural R.R. [In Russian.] Map. *Izviestiia* Archangel Soc. for the Explor. of north Russia, No. 7, pp. 6-27, 1909.

Switzerland

VALLOT, HENRI. Esquisse orographique des Aiguilles de Chamonix du Col du Plan à L'Aiguilles de L'M. Map, Ills. *La Montague*, Vol. 5, No. 11, pp. 648-56, Paris, 1909.

POLAR REGIONS

BRUCE, WILLIAM S. Aims and Objects of Modern Polar Exploration. *Fortnightly Review*, New Series No. DIV, pp. 1028-37, Dec., 1908.

WICHMANN, H. Die Erreichung des Nordpols durch Cook und Peary. Map. *Pet. Mitt.*, Vol. 55, No. 10, pp. 249-53, 1909.

—— Peary contre Cook. À qui le Pôle nord? 127 pp. Éditions Nilsson, Paris, 1909.

ANTHROPO-GEOGRAPHY

FRIEDRICH, PROF. DR. E. Die Fortschritte der Anthropogeographie (1891-1907). *Geographisches Jahrbuch*, Vol. 32, Erste Hälfte, pp. 2-68, Justus Perthes, Gotha, 1909.

ANTHROPOLOGY AND BIOGRAPHY

BROWN, A. R. The Religion of the Andaman Islanders. *Folk-Lore*, Vol. 20, No. 3, pp. 257-71, London, 1909.

GODDARD, PLINY EARLE. Kato Texts. [Collected from a part of the Athapaskans of California.] Amer. Archæology and Ethnology, Univ. of California Publications, Vol. 5, No. 3, pp. 65-238, 1909.

FRIES, TH. M. Bref till och Från Svenska Enskilda Personer. Första Afdelningen Del III "Bref och Skrifvelser af och till Carl von Linné." 342 pp. Upsala University, Stockholm, 1909.

SARASIN, DR. PAUL. Einige Bemerkungen zur Eolithologie. *Jahresbericht* der Geog.-Eth. Gesell. in Zürich, 1908-9, pp. 209-20, 1909.

STOLL, PROF. DR. OTTO. Zur Kenntnis des Zauberglaubens, der Volksmagie und Volksmedizin in der Schweiz. Ills. *Jahresbericht* der Geog.-Eth. Gesellsch. in Zürich, 1908-9, pp. 37-208, 1909.

SWANTON, JOHN R. Tlingit Myths and Texts. *Bull.* 39, Bur. Amer. Ethnol., 451 pp., Washington, 1909.

—— The Antiquity of Man in South America. *Nature*, Vol. 81, No. 2087, pp. 534-5, London, 1909.

BIBLIOGRAPHY

THORBECKE, F. *Geographische Zeitschrift.* Register zu den ersten 10 Jahrgängen, 1895-1904. 118 pp., Leipzig, 1909.

BIOLOGY

ANDREWS, ROY C. Observations on the Habits of the Finback and Humpback Whales of the Eastern North Pacific. Ills. *Bull.* Amer. Museum of Nat. His., Vol. 26, 1909, pp. 213-226.

ECKARDT, W. R. Über die Gründe der Artenarmut Mittel-Europas an Holzgewächsen und das Akklimatisationsproblem. *Geog. Zeitsch.*, Vol. 15, No. 11, pp. 609-20, Leipzig, 1909.

KUZNEZOV, N. List of Insects on the North Shore of the Aral Sea. [In Russian.] Ills. *Izviestiia*, Turkestan Sec. I. R. Geog. Soc., Vol. 4, No. 8, pp. 103-121, 1908.

MEISNER, V. Microscopic Fauna of the Aral Sea. [In Russian.] Ills. *Izviestiia* Turkestan Sec. I. R. Geog. Soc., Vol. 4, No. 8, pp. 1-102, 1908.

NICHOLS, JOHN T. A Note on the Dolphins (Coryphæna Equisetis and Coryphæna Hippurus). *Bull.* Amer. Museum of Nat. His., Vol. 26, pp. 131-133, 1909.

OSTENFELD, DR. C. H. The Phytoplankton of the Aral Sea and its Affluents with an Enumeration of the Algæ observed. Tables and Ills. *Izviestiia*, Turkestan Branch I. R. Geog. Soc., Vol. 4, No. 8, pp. 123-200, 1908.

ECONOMIC GEOGRAPHY

DALTON, LEONARD V. On the Origin of Petroleum. *Econ. Geol.*, Vol. 4, No. 7, pp. 603-31, 1909.

GROUT, FRANK F. The Classification of Coal. *Econ. Geol.*, Vol. 4, No. 7, pp. 653-8, 1909.

—— Chicle, the Basis of Chewing Gum. Ills. *Bull.* Amer. Repubs., Vol. 29, No. 10, pp. 707-15, 1909.

XUM

EDUCATIONAL

ALMADA NEGREIROS, A. DE. L'instruction dans les colonies portugaises. *L'enseignement aux Indigènes,* 9me Série, Tome 1, Institut Col. Intern., Brussels, pp. 397-452, 1909.

CALKINS, R. D. Orientation of Maps. *Jour. of Geog.* Vol. 8, No. 1, pp. 15-17, 1909.

CHAMBERLAIN, JAMES F. Report of Committee on Secondary School Geography. Ills. *Jour. of Geog.,* Vol. 8, No. 1, pp. 1-14, 1909.

The following 6 titles are from *L'enseignement aux Indigènes,* 9me Série, Tome 1, Institut Col. Intern., Brussels, 1909:

FROIDEVAUX, HENRI. L'enseignement indigène dans les colonies françaises. pp. 455-613.

HEILBRON, J.-J. Quelques renseignements sur l'instruction publique de la colonie de Surinam. pp. 167-240.

HOEKMAN, J.-G. L'enseignement des indigènes aux Indes orientales néerlandaises, pp. 17-163.

PEEL, HOME. L'enseignement des indigènes dans l'Inde britannique, pp. 289-364.

ZIMMERMANN, DR. ALFRED. Renseignements sur l'instruction des indigènes dans les colonies allemandes, pp. 367-376.

—— L'enseignement des indigènes dans la Colonie du Congo belge, pp. 379-393.

HISTORICAL GEOGRAPHY

BACCHIANI, ALESSANDRO. Giovanni da Varrazzano e le sue scoperte nell' America settentrionale (1524). Ill. *Boll.* della Soc. Geog. Ital., Vol. 10, No. 11, pp. 1274-1323, Rome, 1909.

MATHEMATICAL GEOGRAPHY

GALITZIN, PRINCE B. Zur Frage der Bestimmung des Azimuts des Epizentrums eines Bebens. *Izviestiia* Imperial Acad. of Sci., St. Petersburg, No. 14, pp. 999-1012, 1909.

LITTLEHALES, G. W. The Uncertainties of Geographical Position in Polar Exploration. Map. *Proceedings* U. S. Naval Institute, Vol. 35, No. 4, Annapolis, pp. 1043-54, 1909.

NOMENCLATURE

VALLOT, HENRI. L'attribution des noms nouveaux en haute montagne. *La Montagne,* Vol. 5, No. 11, pp. 637-47, Paris, 1909.

PHYSICAL GEOGRAPHY

BAUER, L. A., AND W. J. PETERS. First Magnetic Results obtained on the *Carnegie* in the North Atlantic. Ills. *Nature,* Vol. 81, No. 2087, pp. 529-33, London, 1909.

FOREL, DR. F.-A., E. MURET AND DR. P. L. MERCANTON. Les variations périodiques des glaciers des Alpes suisses. Ills. Vingt-neuvième rapport.-1908 *Jahrbuch* des Schweizer-Alpenclub, 1908-09, Bern, pp. 286-312, 1909.

HESS, HANS. Fortschritte der Gletscherkunde. *Gaea,* Vol. 45, No. 10, pp. 574-89, Stuttgart, 1909.

XUM

MECKING, DR. LUDWIG. Petterssons Stromstudien an der Pforte der Ostsee. *Annalen der Hydrog. u. Marit. Meteor.*, No. 12, pp. 554-558, 1909.

MÜHLHOFER, LIEUT. F. Die Erforschung des Wasserschlingers von Dane bei St. Kanzian im Küstenlande. Zum Studium des Problems der Höhlenflüsse. Ills. *Globus*, Vol. 96, No. 14, pp. 213-17, 1909.

OMORI, F. Preliminary Report on the Messina-Reggio Earthquake of Dec. 28, 1908. *Bull.* of the Imperial Earthquake Invest. Comm. No. 2, Vol. 3, Tokyo, pp. 37-45, 1909.

OMORI, F. Report on the Observation of Pulsatory Oscillations in Japan. 1st Paper. Ills. *Bull.* Imper. Earthquake Comm., Vol. 3, No. 1, 35 pp., Tokyo, 1909.

POLLITZ, THEODOR. Die Stürme im südlichen Indischen Ozean. Eine Untersuchung ihrer Häufigkeit, Anfangsrichtung, Dauer, Winddrehung und Luftdruckverhältnisse. Tables and Diagrams. *Annal der Hydrog. u. Marit. Meteor.*, No. 12, pp. 529-553, 1909.

SCHNEIDER, DR. KARL. Über neue geotektonische Untersuchungen. *Gaea*, Vol. 45, No. 10, pp. 561-74, Stuttgart, 1909. [Discusses also the geographical distribution of Earthquakes and Volcanoes.]

SIMONSEN, CAPT. A. Lotungen an der Küste von Brasilien zwischen Kap Bianco und Kap Frio und bei der Insel Fernando Noronha. 1902 bis 1908. Tables. *Annalen d. Hydrog., u. Marit. Meteor.*, No. 12, pp. 558-563, 1909.

SPENCER, J. W. On the Physiographic Improbability of Land at the North Pole. Map. *Amer. Jour. of Science*, Vol. 19, pp. 533-44, 1905.

SPENCER, J. W. The Submarine Great Canyon of the Hudson River. *Amer. Jour. of Sci.*, Vol. 19, 15 pp., Jan., 1905.

SPETHMANN, DR. HANS. Beiträge zur Kenntnis des Vulkanismus am Mückensee auf Island. Ill. *Globus*, Vol. 96, No. 13, pp. 201-5, 1909.

—— Principal Facts of the Earth's Magnetism and Methods of determining the True Meridian and the Magnetic Declination. 96 pp. Reprinted from U. S. Mag. Declin. Tables and Isogonic Charts for 1902, Washington, 1909.

NEW MAPS

NORTH AMERICA

UNITED STATES GEOLOGICAL SURVEY MAPS

TOPOGRAPHIC SURVEY SHEETS. *Alaska:* Reconnaissance Map of the Fairbanks Quadrangle, 1:250,000, contour interval 200 feet; Reconnaissance Map of Rampart Quad., Yukon-Tanana Region, 1:250,000, interval 200 ft. *Arizona:* Roosevelt Quad., 1:125,000, interval 100 ft. *California:* Kaweah Quad., 1:250,000, interval 100 ft.; Yosemite Quad., 1:125,000, interval 100 ft. *Colorado:* Colorado Springs Quad., 1:125,000, interval 100 ft.; Pikes Peak Special Map, 1:48,000, interval 50 ft. *Georgia:* Acworth Quad., 1:62,500, interval 50 ft. *Illinois:* Tallula Quad., 1:62,500, interval 10 ft. *Kentucky:* Madisonville Quad., 1:62,500, interval 20 ft.; Providence Quad., 1:62,500, interval 20 ft. *Maryland:* Mount Airy Quad., 1:62,500, interval 20 ft.; Ijamsville Quad., 1:62,500, interval 20 ft. *Michigan:* Howell Quad., 1:62,500, interval 20 ft. *Missouri-Illinois:* Weingarten Quad., 1:62,500, interval 20 ft. *Montana-North Dakota:* Glendive

Quad., 1:250,000, interval 50 ft. *New Mexico:* Santa Rita Special Map, 1:24,000, interval 20 ft.; Silver City Quad., 1:125,000, interval 100 ft. *New York:* Cooperstown Quad., 1:62,500, interval 20 ft. *North Carolina:* Coharie Quad., 1:62,500, interval 10 ft. *Ohio:* Alliance Quad., 1:62,500, interval 20 ft. *Ohio-Penn.:* Columbiana Quad., 1:62,500, interval 20 ft. *Oklahoma:* McAlester Quad., 1:125,000, interval 50 ft. *Oklahoma-Missouri-Kansas:* Wyandotte Quad., 1:125,000, interval 50 ft. *Pennsylvania:* Freeport Quad., 1:62,500, interval 20 ft. *South Carolina-North Carolina:* Gaffney Quad., 1:62,500, interval, 20 ft. *Tennessee:* Franklin Quad., 1:62,500, interval 20 ft. *Tenn.-Ga.-N. C.:* Ducktown Special Map, 1:36,000, interval 20 ft. *Utah:* Strawberry Valley Quad., 1:125,000, interval 100 ft. *Washington:* Seattle Special Quad., 1:62,500, interval 25 ft. *West Virginia:* Charleston Special Quad., 1:62,500, interval 50 ft.; Clendenin Quad., 1:62,500, interval 50 ft.; Elkins Quad., 1:62,500, interval 50 ft.; Midkiff Quad., 1:62,500, interval 50 ft.; St. Albans Quad., 1:62,500, interval 50 ft.; Wayne Quad., 1:62,500, interval 50 ft. *Wisconsin:* Oconomowoc Quad., 1:62,500, interval 20 ft.; Sparta Quad., 1:62,500, interval 20 ft.

COLORADO. Pleistocene Geology of the Leadville Quadrangle, Col. 1:125,000=1.9 mile to an inch. By Stephen R. Capps, Jr. 39°-39° 30′ N.; 106°-106° 30′ W. In *Bull.* 386, U. S. Geol. Surv., 1909. [Colored for formations, contour intervals, 25, 50, and 100 ft.]

MONTANA. Geologic Map and Sections of Lewistown Coal Field, Montana. 1:125,000=1.9 mile to an inch. By W. R. Calvert. In *Bull.* 390, U. S. Geol. Surv., 1909. [Geology in colors, contour interval, 100 ft,, and 4 geological sections showing coal horizons.]

MONTANA. Economic Map of Lewiston Coal Field, Montana, 1 inch=4 miles. In *Bull.* 390, U. S. Geol. Surv., 1909. [Shows coal outcrops, areas of more valuable coal, etc.]

SOUTH DAKOTA. (a) Map of South Dakota showing the Artesian Conditions. 1:1,267,200=20 miles to an inch. [Colored to show formations and depths of Dakota sandstone. Figures in red show depths of artesian wells in feet.] (b) Geologic Map of ———. Same Scale. [16 tints showing formations.] (c) Map of ——— showing the Structure of the Dakota Sandstone. 1 inch=40 miles. [Colored to show different conditions of the sandstone and areas where it is absent. Red contours show altitude of the top of sandstone above sea level.] (d) Map of ——— Artesian Area, showing relative Volumes of Flows from Wells. 1 inch=55 miles. (e) Map showing contour and altitude of Bed-Rock Surface in a Portion of ———. 1 inch=28 miles [Colored.] In "Geology and Underground Waters of South Dakota." By N. H. Darton. *Water Supply Paper* 227, U. S. Geol. Surv., Washington, D. C., 1909.

U. S. HYDROGRAPHIC OFFICE CHARTS

Pilot Charts of the North Atlantic Ocean, Nov., Dec., 1909.
Pilot Charts of the North Pacific Ocean, Dec., 1909, Jan., 1910.
Pilot Chart of the South Atlantic Ocean, Dec., 1909, Jan. and Feb., 1910.
Pilot Chart of the South Pacific Ocean, Dec., 1909, Jan. and Feb., 1910.

U. S. WEATHER BUREAU MAPS

Meteorological Chart of the North Atlantic Ocean, Jan., Feb., 1910.
Meteorological Chart of the North Pacific Ocean, Jan., Feb., 1910.

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UNITED STATES. Chart of the Indiana Coal Field. 1 in.=4 miles. By Edwin F. Lines. With "Supplementary Report on the Coal of Indiana," by George H. Ashley. Department of Geol. and Nat. Resources of Indiana in co-operation with U. S. Geol. Surv., Indianapolis, 1909.

CANADA. Geological Map showing Coal Areas in Alberta, Saskatchewan and Manitoba. No. 1010. 1:2,217,600=35 miles to an inch. 49°-57° N.; 95°-123° W. By D. B. Dowling. With diagrammatic section. In "The Coal Fields of Manitoba, Saskatchewan, Alberta and E. British Columbia," Dep't. of Mines, Geol. Surv. Branch, Ottawa, Can., 1909. [Shows in colors, the different coal formations, and outcrops and the places where analyses have been made.]

CANADAS Geological Survey Map of portions of the Districts of Algoma and Thunder Bay, Ontario. No. 964. To Illustrate Reports of W. J. Wilson and W. H. Collins, 1903-5. 1:506,880=8 miles to an inch. 48° 20′-51° 45′ N.; 83°-89° W. Dep't of Mines, Geol. Surv. Branch, Ottawa, Can., 1909. [5 tints to show formations along the river courses.]

CANADA. Standard Topographical Map. Sheets Belleville and English R., Ontario, and Pembroke, Ontario and Quebec. 1:250,000=3.95 miles to an inch. Dep't. of the Interior, James White, Chief Geographer, Ottawa, 1909. [In a letter to *The Geographical Journal* (Vol. 34, p. 686), replying to criticisms of the sheets of the "Standard Topographical Map" by Major E. H. Hills, Mr. White says that this map is based on the triangulation of the U. S. Lake Survey and on the survey of the north shore of Lake Erie by Dr. Klotz. "For the balance, my maps are based on transit and chain traverses made under my direction, and tied to points that have been accurately determined in latitude and longitude by the staff of the chief astronomer; on the transit and chain surveys for railways, canals, etc." As to the criticism that the sheets contain no contours, hill-shading or heights, in other words, no representation of the form of the ground, Mr. White says that such information was not available at the time of publication, though the elevations of railway stations, principal lakes, etc., are printed on the sheets. As fast as topographic information is available it will be incorporated on new editions of the sheets. In reply to the criticism that the map should not be called "topographical" because it does not show the ground forms, Mr. White says he adopted the name "Standard Topographical Map" and will adhere to it. In notices of these sheets, the *Bulletin* has remarked that the word "Topographical," in the title, is certainly not used in the sense which the geographers of this country apply to it.]

SOUTH AMERICA

BRAZIL. Topographic Map of the State of São Paulo. Folha de S. Bento. 1:100,000=1.5 mile to an inch. (Preliminary Edition.) 22° 30′-23° S.; 2° 30′-3° W. Long. from Rio de Janeiro. Commissão Geographica e Geologica de S. Paulo, São Paulo, 1909. [The contour interval is 25 meters.]

BRAZIL. Mappa do Sul do Brazil. Organisado por Gentil de Assis Moura. 1:2,500,000=39.4 miles to an inch. 15°-32° 30′ S.; 7° E.-19° W. Long. from Rio de Janeiro. European Agents, L. Friederichsen & Co., Hamburg. 25 M. [The compiler of this fine map is connected with the Geographical and Geological Commission of São Paulo which is producing the topographic map of that State. The map includes the States of Rio Grande do Sul, Sta. Catharina, Paraná, São

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Paulo, Rio de Janeiro, Espirito Santo, most of Matto Grosso, Goyaz and Minas Geraes and the southern part of Bahia. All available surveys and information have been used, the hydrography and coast lines are sharply defined, the printing is excellent and the very large nomenclature is easily read. The least satisfactory feature is the inadequate expression of the mountains, indicated by brown wash. For general purposes this is probably the most satisfactory map of southern Brazil yet produced.]

DUTCH GUIANA. Kaart van Suriname. 1:1,000,000=15.78 miles to an inch. With "Geologische-en technische Aanteekeningen over de Goudindustrie in Suriname" door E. Middelberg. J. H. de Bussy, Amsterdam, 1908. [Colored for formations. Mining concessions shown.]

PERU. Mapa que comprende las ultimas Exploraciones y Estudios verificados desde 1900 hasta 1906. 1:1,000,000=15.78 miles to an inch. 8°-14° S.; 69°-76° 15′ W. *Bol.* Soc. Geog. de Lima, Año 17, Tomo 21, Trimestre Cuarto, Lima, 1907. [Imposed upon a map in colors of this part of eastern Peru, are the results of the explorations of Col. Portillo and of the surveys for the Central and the projected Eastern railroads, including the first mapping of some of the tributaries of the Rio Madre de Dios.]

PERU. Croquis de los Rios alto Ucayali y bajo Urubamba. 1:500,000=7.5 miles to an inch. 9° 45′ S.; 72° 50′-74° 55′ W. *Bol.* Soc. Geog. de Lima, Año 18, Tomo 23, Trimestre Primero, Lima, 1908. [Based upon the surveys of Col. D. Pedro Portillo. The navigable channels are traced in red according to the studies of Engineer Wertheman and the data of the Portillo expedition of 1900.]

AFRICA

BELGIAN CONGO. Carte commerciale du Congo belge. 1:8,000,000=126.2 miles to an inch. Illustrates "Les Réformes" in *Le Mouve. Géog.*, Vol. 26, No. 44, Cols. 518-26, Brussels, 1909. [Shows in colors the areas that are to be restored to the natives in the years 1910-12, those which will be reserved by the State and the concessions to trading companies which may be subject to revision.]

DAHOMEY. Carte ethnographique et administrative du Dahomey. No scale or map net. *L'Afrique Française*, Vol. 19, No. 11, 1909. [Black and white map reproduced from the ethnographic map recently prepared by the Lieut. Governor of the Colony. Shows the distribution of the tribes.]

DAHOMEY. Carte géologique du Dahomey et dépendances. 1:250,000=3.95 miles to an inch. 6°-14° N.; 2° 45′ W.-1° 45′ E. from Paris. [In "Mission scientifique au Dahomey," by Henry Hubert. Larose, Paris, 1908. 14 colored symbols for formations and 2 geological profiles.]

NORTHEAST RHODESIA. Die Wasserscheide zwischen Zambesi und Kongo. 1:5,000,000=78.9 miles to an inch. 8°-15° 40′ S.; 27°-34° 30′ E. By Albert Bencke. Illustrates paper with same title. *Deutsche Runds. f. Geog. u. Stat.*, Vol. 32, No. 2, Vienna, 1909. [Colored for elevations above sea level.]

WEST AFRICA. Regenverteilung und Pflanzendecke Ober-Guineas und des westlichen Sudans. 1:20,000,000=315.6 miles to an inch. With paper of same title in *Geog. Zeitsch.*, Vol. 15, No. 11, Leipzig, 1909. [A black and white sketch showing distribution of steppe, savanna and forest. Numerals scattered over map show number of dry months (under 30 mm.), in the year.]

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ASIA

FRENCH INDO-CHINA. Carte topographique du Service géographique de l'Indo-Chine. 1 inch=1.5 mile. That-kme (Cao-bang.) Hanoi, Tonkin, 1907. [Colors for geological formations.]

FRENCH INDO-CHINA. Carte géologique provisoire du Service des Mines de l'Indo-Chine. 1:100,000=1.5 mile to an inch. That-kme (18.) Hanoi, Tonkin, 1907. [Geologically colored and positions of mineral fields, located, in working or abandoned, and of fosiliferous beds, are indicated.]

FRENCH INDO-CHINA. The following maps appear in *Mémoires* de la Soc. Géol. de France, 4th Series, Vol. 1, Memoirs 3, 4 and 5. Paris, 1907: (a) Carte géologique des feuilles That-Khé, Loung-Tchéou et Pho-Binh-Gia. 1:500,000= 7.89 miles to an inch. With *Memoir* 3, "Contribution a l'Étude géologique du Haut-Tonkin," by Capt. G. Zeil; (b) Esquisse d'une Carte géologique du Tonkin d'après les récentes reconnaissances du Service géologique et des officiers du Service géographique de l'Indo-Chine. 1:1,500,000=23.67 miles to an inch. With *Memoir* No. 4, "Note sur la Géologie de l'Indo-Chine," by H. Lantenois. [10 colored symbols and white for formations]; (c) Esquisse géologique du Sud de l'Indo-Chine française. 1:5,000,000=78.9 miles to an inch. Par. René de Lamothe. With *Memoir* 5, "Note sur la Géologie du Cambodge et du Bas-Laos." [7 colored symbols for formation.]

INDIA. Britisch Indien. 2 Maps. (a) Jährliche Niederschlagsmenge. [Six symbols for distribution of rainfall]; (b) Gebiete der häufigsten Dürren-Kalamität. In paper "Über Dürren in Britisch-Indien," *Jahresbericht* der Geog.-Eth. Gesell. in Zürich, 1908-9.

MANCHURIA-HARBIN. La Carte des environs de la ville Kharbin. 1 inch= about 2 miles. Illustrates "Observations météorologiques en Mandchourie," 1-r fascicule. L'Observatoire physique Central Nicolas, St. Petersburg, 1909. [A black and white map with contours of elevation, meteorological station, Chinese villages, etc.]

PHILIPPINES. Sketch Map of Northwestern Luzon. No Scale. Illustrates "Distributions of the Non-Christian Tribes of N. W. Luzon" in *Amer. Anthrop.*, Vol. 11, No. 3, 1909. [Shows distribution of Christian and non-Christian settlements.]

AUSTRALASIA AND OCEANIA

TASMANIA. Geological Sketch Map of the North Coast of Tasmania from River Tamar to Circular Head. 1 inch=3 miles. Illustrates paper in *Proc.* Linnean Soc. of N. S. W., Vol. 32, Part 4, Sydney, 1909. [Black and white map with symbols for formations and profile of the coast.]

EUROPE

AUSTRIA. (*a*) Touristen Wanderkarte der Niederösterr. steirischen Alpen u. Voralpen (östlicher Theil); (b) Blatt 6: Reisalpen. Unterberg; (c) 15: Das Gesäuse u. seine Berge; (d) 17: Wachau u. Dunkelsteiner Wald; (e) 22: Waidhofen a. d. Ybbs u. Umgebung. Freytag & Berndt, Vienna, 1909. [Specimens of the convenient, small tourist maps issued by this firm, all on a scale of 1:100,000=1.5 mile to an inch. Clear and artistic maps of mountain regions that are attractive to tourists and easily accessible from Vienna. Descriptive letterpress on the reverse.]

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AUSTRIA. G. Freytag's Plan des Verkehrszentrums von Vienna. 1:20,000= 1.8 mile to an inch. Freytag & Berndt, Vienna. 40 Heller. [Transportation routes in blue and sketch map showing ward boundaries of the city.]

AUSTRIA. Parts of Vienna: (a) Bezirk Döbling. 1:20,000; (b) Bezirk Fünfhaus. 1:10,000. Freytag & Berndt, Vienna. [Hand maps of Vienna wards for use in the public schools.]

AUSTRIA-HUNGARY AND DEPENDENCIES. Triaskarte der Habsburger Monarchie. 1:1,500,000=23.67 miles to an inch. G. Freytag & Berndt, Vienna. [The purpose is to show by red boundaries (Austria), green (Hungary) and blue (Bosnia and Herzegovina) the geographical relations of the constituent parts of the Hapsburg Monarchy.]

BALKAN STATES. Az északi Balkán Katonai térképe. 1:800,000=12.6 miles to an inch. 40° 15′-45° 35′ N.; 13° 50′-23° 30′ E. Illustrates paper by Jenö Cholnoky in *Bull.* of the Hungarian Geog. Soc., Vol. 37, No. 3. Budapest, 1909. [A good map of the Balkan States as far east as Salonica. A large amount of detail clearly expressed.]

SCOTLAND. Geological Map of Scotland. 1:633,600=10 miles to an inch. New Edition. Reduced chiefly from the Ordnance and Geological Surveys under the direction of Sir Archibald Geikie. Topography by John Bartholomew. With Memoir. John Bartholomew & Co., Edinburgh, 1910. 7s 6d. [The map is folded with the memoir containing 31 pp. of explanatory notes, by Sir Archibald Geikie. The first edition was published in 1892 since which time considerable progress has been made in the geological mapping of the Highlands. Sir Archibald Geikie has revised the notes to represent the present state of our knowledge. On the margins are geological sections through parts of the country.]

SCOTLAND. Pocket Plan of Edinburgh and Suburbs. 1 inch=500 yards. John Bartholomew & Co., Edinburgh, 1909. Paper, 6d; cloth, 1s. [A map in colors on a scale so large that all street names and other nomenclature are easy to read. The indexes to streets, railroad stations, places of interest, etc., on the margins, facilitate reference to all information.]

FRANCE AND SWITZERLAND. La chaîne du Mont Blanc. Nouvelle édition de 1906 en 4 feuilles. IV. Massif du Trient. 1:50,000=0.7 mile to an inch. Beilagen zum Jahrbuch des Schweizer Alpenclub, Band 44, Stämpfli, Bern, 1909. [Ground forms shown by contours with 50 meters interval.]

OCEANS

ATLANTIC OCEAN. Lotungen zwischen Bahia u. den Abrolhos, und Kap Frio, Brasilien. No Scale. 19° 20′-24° S.; 39° 15′-42° 15′ W. Ausgeführt von Kapt. A. Simonsen, 1902-8. [With paper of same title in *Ann. d. Hydrog. u. Mar. Meteorol.*, Vol. 37, No. 12, 1909. A black and white Chart giving soundings for 10 to 40 miles outside those on the British Admiralty Chart. Indicates the nature of the sea floor, the area of greatest depths and the depths formerly given at places resounded.

ATLANTIC OCEAN. Lotungen bei der Insel Fernando Noronha [Brazil]. Scale, 1 inch=1 1/5 nautical mile. Ausgeführt von Kapt. A. Simonsen, 1906-8. *Ann. d. Hydrog. u. Mar. Meteorol.*, Vol. 37, No. 12, 1909.

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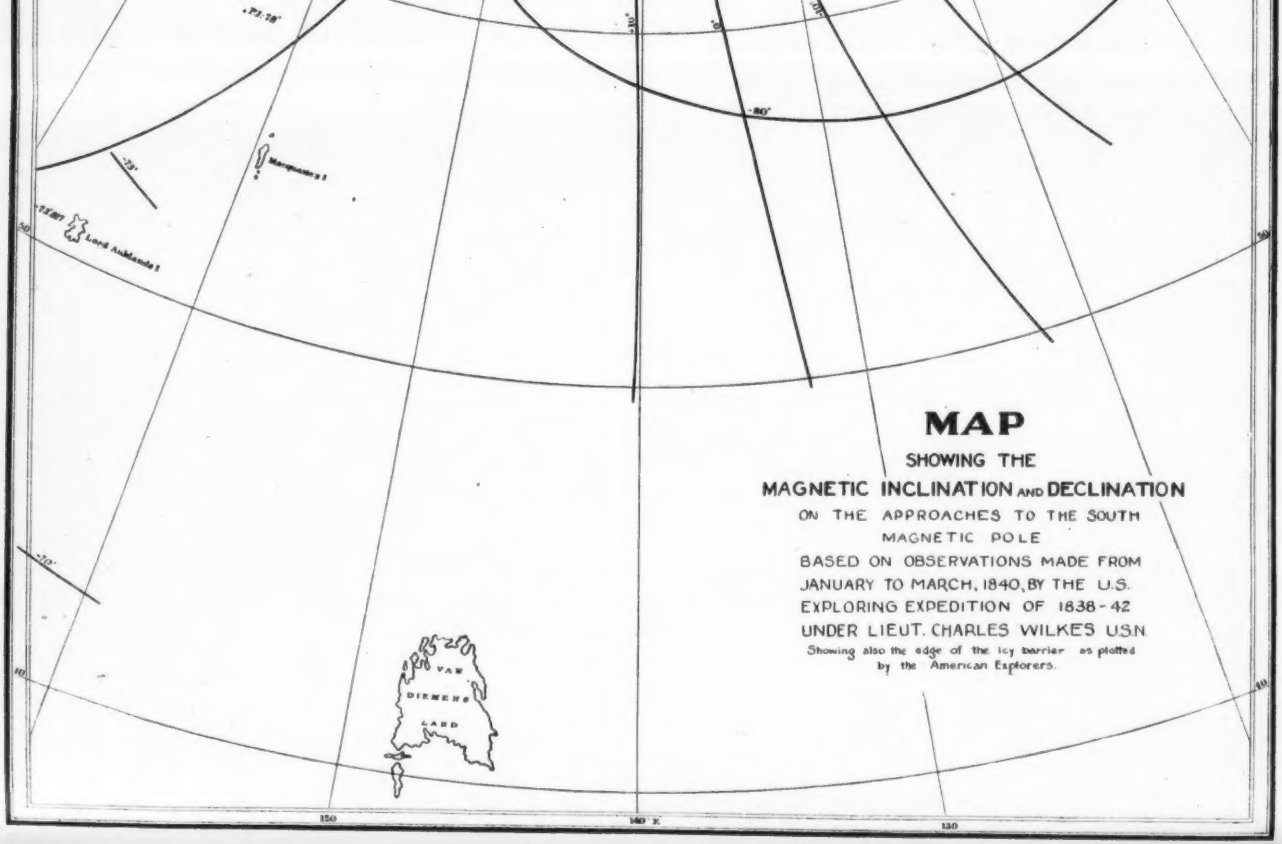

MAP

SHOWING THE

MAGNETIC INCLINATION AND DECLINATION

ON THE APPROACHES TO THE SOUTH MAGNETIC POLE

BASED ON OBSERVATIONS MADE FROM JANUARY TO MARCH, 1840, BY THE U.S. EXPLORING EXPEDITION OF 1838-42 UNDER LIEUT. CHARLES WILKES U.S.N.

Showing also the edge of the Icy barrier as plotted by the American Explorers.

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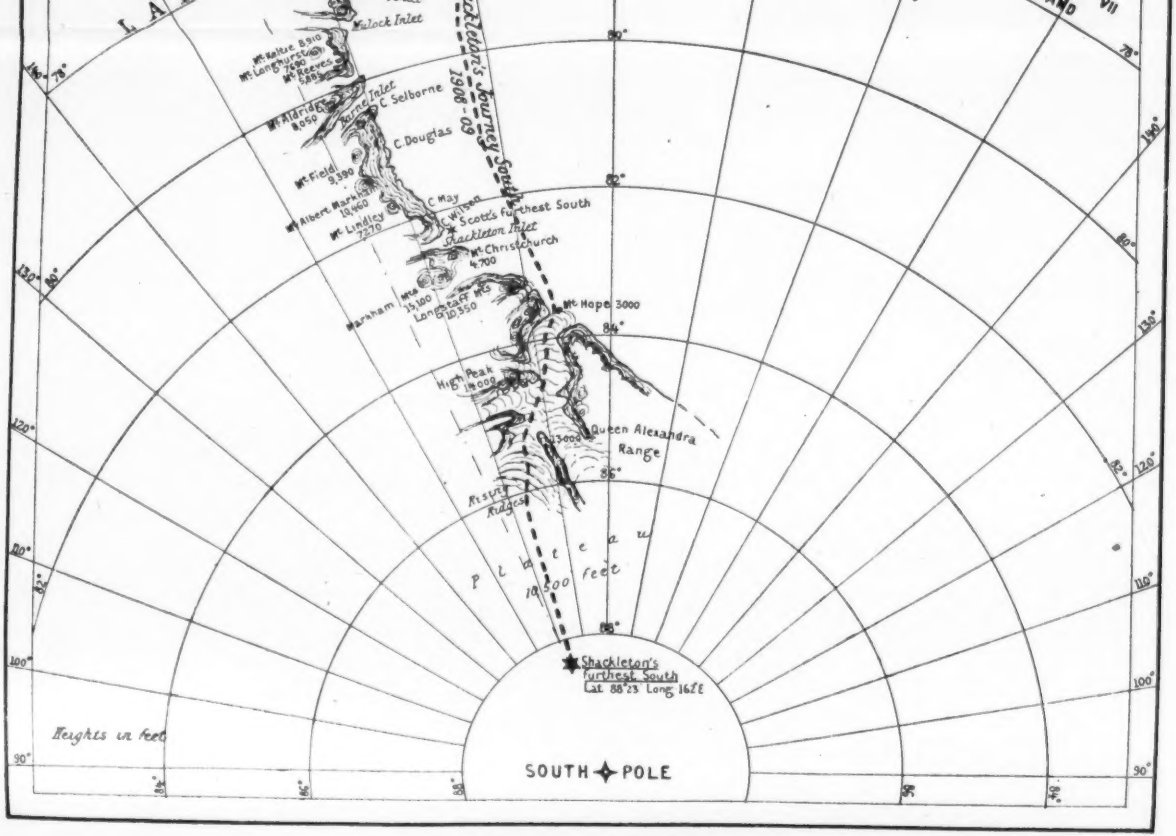
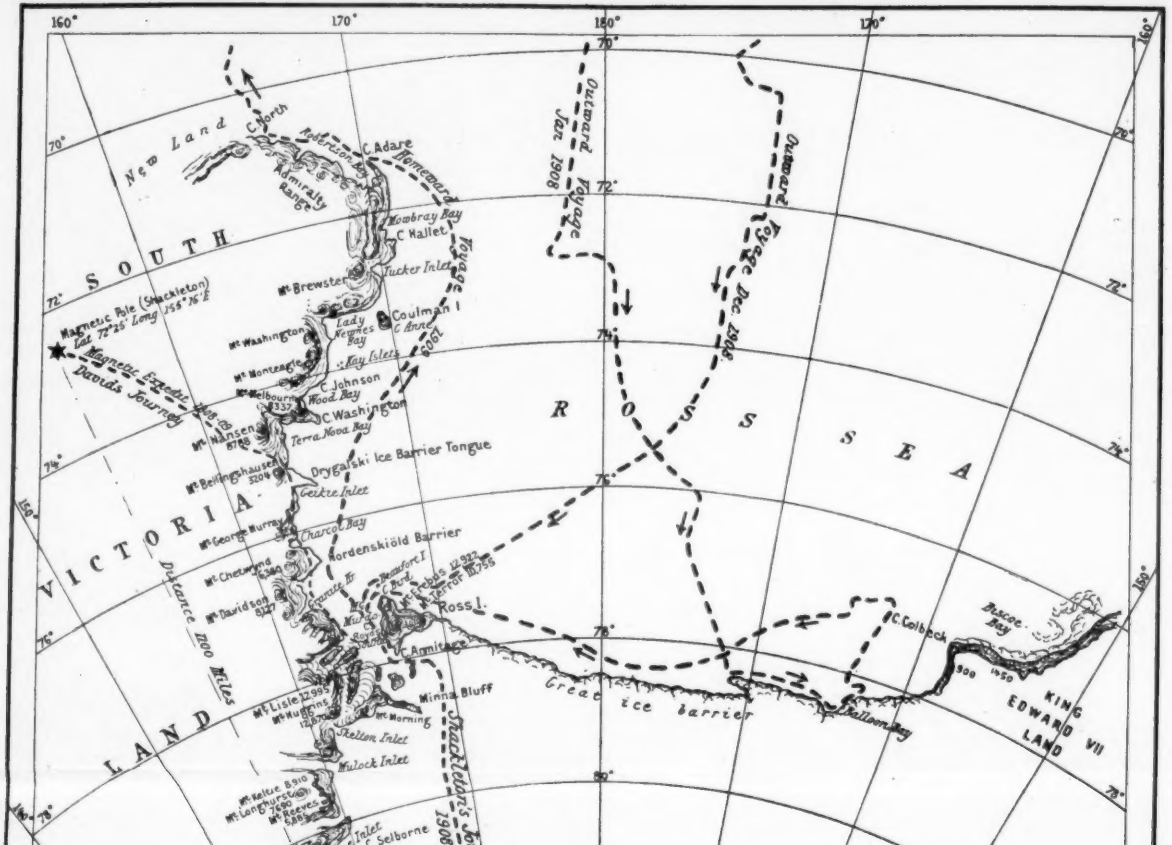


ROUTES OF THE SHACKLETON EXPEDITION.


160°
170°
180°
170°
160°
70°
72°
74°
76°
78°
80°
SOUTH
VICTORIA
LAND
ROSS SEA
New Land
C North
Admiralty Range
Robertson Bay
C Adare
Homeward Journey 1908
Outward Voyage 1908
Outward Voyage Dec 1908
Mowbray Bay
C Hallett
Tucker Inlet
Mt Brewster
Coulman I
C Anne
Lady Newnes Bay
Bay Islets
Mt Washington
Mt Montegle
Mt Melbourne 9337
Johnson
Wood Bay
C Washington
Mt Nansen 6788
Terra Nova Bay
Mt Berlingshausen 5209
Drygalski Ice Barrier Tongue
Geikie Inlet
Mt George Murray
Charcot Bay
Mt Chetwynd 5360
Mt Davidson 5427
Nordenskiöld Barrier
Distance 200 Miles
Franklin I
Crater Hill
Mt Terror 10,755
Mt Erebus 12,892
Ross I.
C Armitage
Mt Lisle 12,995
Mt Huggins 12,000
Mt Morning
Minna Bluff
Skelton Inlet
Mulock Inlet
Mt Keltie 8810
Mt Longhurst 8760
Mt Reeves 8,850
Inlet
C Selborne
Shackleton's Journey 1908
Great ice barrier
Balleny Is
C Colbeck
Discovery Bay
900
1950
KING EDWARD VII LAND
Magnetic Pole (Shackleton) Lat 72°25' Long 155°16'E
Magnetic Expedition
Davids Journey
Mts 8000 ft

THE NEW BUILDING OF THE AMERICAN GEOGRAPHICAL SOCIETY